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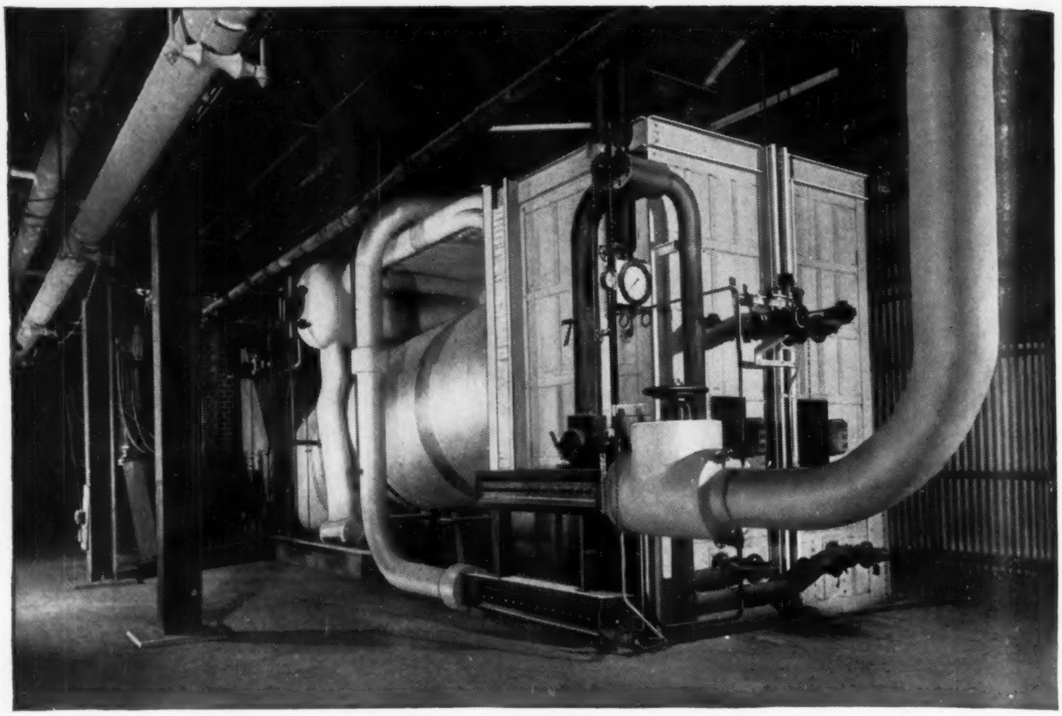

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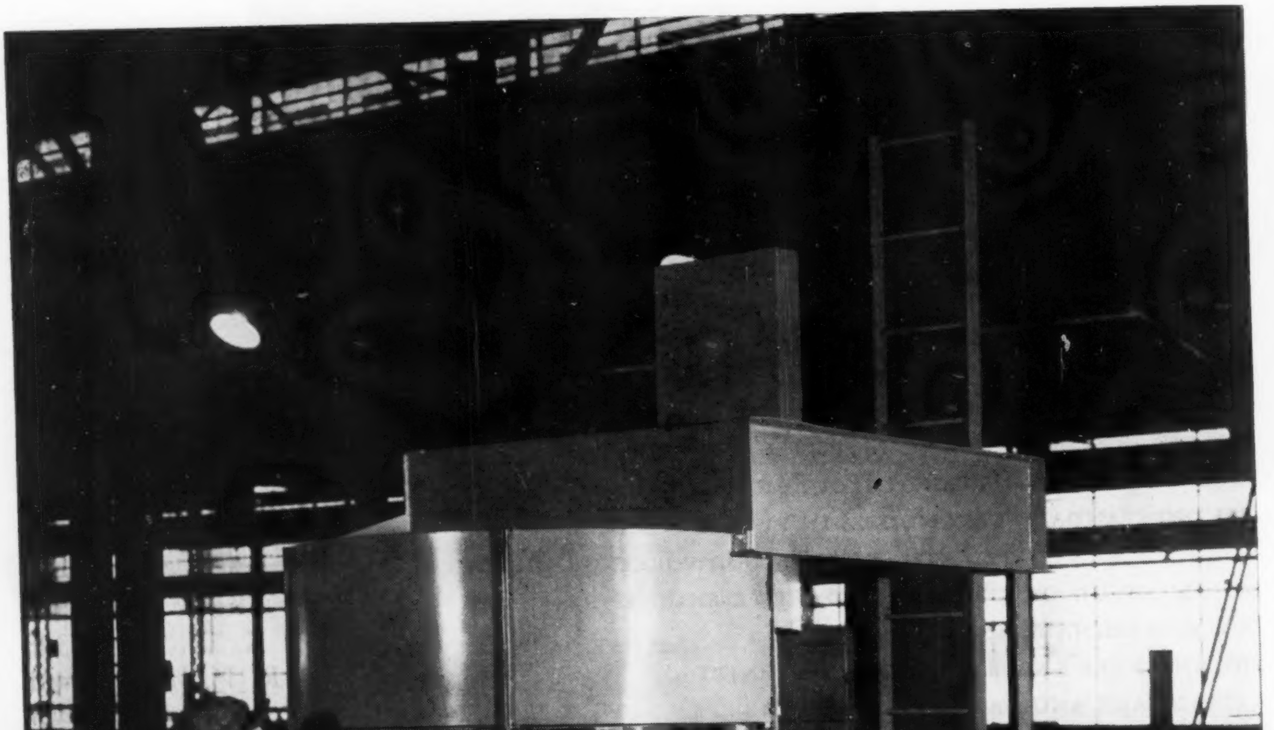
MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 67 NUMBER 6

Contents for June, 1945

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $6.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters two weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . .



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VOLUME 67
No. 6

MECHANICAL ENGINEERING

JUNE
1945

GEORGE A. STETSON, *Editor*

Janet E. Bachman

MEMBERS of The American Society of Mechanical Engineers who have been frequent visitors at headquarters and Annual Meetings will grieve to learn of the death, on April 29, 1945, of Janet E. Bachman of the A.S.M.E. staff.

Miss Bachman had recently completed 25 years of service with the Society. Her first assignment was in the Editorial Department as secretary to C. E. Davies. When Colonel Davies took over the administration of the national meetings of the Society, Miss Bachman was transferred to this work and bore an increasing portion of the burden of the task until she was forced by fatal illness to relinquish it.

Possessing an orderly and objective mind, a high sense of duty and responsibility, a capacity and willingness to work long hours when occasion demanded, she became one of the faithful group of women who bear a large share of the work and details of Society administration.

The frankness of her speech and manner was evidence of an honest and forthright nature and of a desire to carry on her work in a businesslike and unemotional way. If she was relentless with authors whose promised papers were late, she was equally persistent in the performance of her own tasks. With the program completed and the Annual Meeting under way she did not relax, but spent long hours attending to emergency details and in the arrangement of seating lists for the Annual Dinner.

Those who knew her well discovered her sensitive and intelligent nature, her abhorrence of sham and pretense, and her loyalty and friendliness, and knew that they could rely upon her to carry out any task assigned to her.

America Needs Engineers

A TASK which should have immediate attention and high priority on the part of the people of the United States is that of education in all its aspects and at all levels. Especially must engineering education receive support because America needs engineers.

Education at primary- and secondary-school levels has popular and public support, although, to judge from the records of men rejected for military service, the results have not been as satisfying as most of us would have expected them to be.

When it comes to education at the college level, we can look back with encouragement to the great increase in registrations since World War I. Opportunities for young people to attend college have been fairly abundant and the question frequently has been raised as to whether we may not have gone in for quantity at the expense of quality. Wiser selection of material, higher standards of attainment, and more money spent to attract and hold better teachers are means for improving quality.

In several areas of education we are on the threshold of promising results, for example, in vocational and adult education. The familiar and somewhat cynical observation that a college education has ruined many a good ditchdigger may be outmoded in an age which digs its ditches by machinery. It was a comment of an era which had little to offer in the way of a college education beyond the so-called arts courses. The modern tendency to vocationalize education may carry the pendulum too far on the opposite side of the center as, indeed, has been the case in engineering education. Intelligently revised curricula and methods of teaching are correcting this fault in so far as engineering education is concerned. On the other hand the growth of vocational education in trade schools and technical institutes is in line with the nation's needs and should be encouraged. Breadth if not depth of general knowledge and understanding and the satisfactions which they bring to the individual can be aided partially by improved public-school education and the development of adult education.

But the most pressing need of the nation at the present moment and in the immediate future lies in the education of scientists and engineers. What many intelligent persons consider a serious mistake in national policy has been our failure, under emergency war conditions, to maintain, to say nothing of increasing, the number of young people soundly educated in the fundamentals of science and engineering. We have not questioned the right or the wisdom of our military leaders in assigning men to combat duty, to the services of supply, or to any other position in any locality. But with relatively rare exceptions the principle has not been followed in handling the manpower problem as a whole, for reasons that are easier to state than to justify. It should be possible, in a democracy, to assess national needs, to recognize differences in intellectual talents, and to provide for the training of men for careers in science and engineering even in wartime.

Our task now is to bend every effort to make up for the lack of men with scientific and engineering training that wartime conditions have created. One encouraging sign of the times is the reported fact that discharged servicemen whose education was interrupted by the war are returning to college to complete their studies. This trend, which is greatly influenced by the G.I. Bill of Rights, should not be allowed to peter out, as it promises rich returns in terms of educational salvage. It also places upon us as a nation the responsibility of rebuilding the faculties that have been dissipated as a result of war activities.

Although the need of industry for engineers is well known, some figures recently made available by Dean A. A. Potter of Purdue University are interesting because they are probably typical. Purdue usually places its graduates with about 400 companies. To obtain a factual picture of the critical shortage of engineers in these companies Dean Potter addressed a communication to about one third of them and received 105 replies. Of the companies which replied, only 8, or 7.6 per cent, indicated that they had no need for additional engineering talent. Ninety-seven, or 92.4 per cent of the 105 companies, however, including both large and small industries, reported a total need of 4590 engineers, or an average of 47 per company.

The companies which reported to Dean Potter may be listed in the following categories: Aircraft 7; chemical, rubber, and oil 25; construction 3; electrical manufacturers 18; machinery and automotive manufacturers 22; railroads and railroad-supply companies 3; steel and other raw-material industries 6; utilities 6; miscellaneous 15.

"The survey," Dean Potter says, "which included only a very small percentage of American industries, revealed an urgent need for 4590 engineers. This would indicate that the total need by American industry of fully trained engineers is certainly many times the shortage reported. This is particularly serious since the output of civilian engineers from all engineering colleges of the United States during the present year will be less than 2000 and will be made up largely of individuals who are physically incapacitated.

"In addition to their present urgent needs the companies were asked to indicate their long-range needs after the emergency is over. These long-range needs for 96 companies total 3509 or 36 engineers per company. These totals will not be affected by the return of veterans since the companies took this into consideration when reporting.

"This survey indicates that the United States of America is now confronted with a critical shortage of engineers. This may prove a serious handicap in expediting the end of the war in all theaters of operation as production of war equipment is bound to be unfavorably affected by the shortage of engineers who have the knowledge to plan, improve, and supervise industrial production.

"The ending of the war will find this nation with many of its national resources greatly depleted and facing from other lands the keenest industrial competition ever conceived. To keep full employment in industry in the years of reconstruction adequate engineering and scientific staffs must be made available to develop new materials and better articles of commerce, and to manufacture them in large quantities at low cost to meet world competition."

Sets an Example

IN April of this year the Schenectady Section of the American Institute of Electrical Engineers issued a modest pamphlet which includes a brief history of that section. On May 23, 1898, a group of engineers in Schenectady organized the General Electric Engineering Society whose purposes were to be strictly engineering in nature and whose members were to be drawn from the technical men employed by the General Electric Company. On Jan. 26, 1903, members of the A.I.E.E. in Schenectady organized a local section of the Institute and on Dec. 15, 1903, the two groups merged as the Schenectady Section, the ninth to be recognized as an active chapter of the national organization.

One cannot read the history of the A.I.E.E. Schenectady Section without being impressed by its vigor and accomplishments. Particularly impressive is the Steinmetz Memorial Lecture, which has been delivered annually with but few exceptions since May 8, 1925, and which brought to Schenectady men of national reputation—Michael I. Pupin, Ernst J. Berg, Robert A. Millikan, Max Mason, D. S. Kimball, W. E. Wickenden, Karl T. Compton, C. E. Kenneth Mees, R. E. Doherty, Gerard Swope, Harold G. Moulton, Igor I. Sikorsky, Frank B. Jewett, Frank Howard Lahey, Comfort A. Adams, H. W. Dodds, and Stephen S. Wise.

Another notable achievement of the section was the co-ordination of the engineering societies in Schenectady which began, with indifferent success at the start, in 1929 and which took definite form in 1934. Early in 1943 the co-ordinating committee was transformed into a formal organization known as the Schenectady Engineering Council.

Publication of the history of the Schenectady Section of A.I.E.E. has a broader usefulness than a record of accomplishments. It sets a high mark for local sections of all engineering societies to shoot at and an example of skillful, intelligent leadership and broadminded cooperation.

Aviation Engineers' Anniversary

JUNE 4 marks the fifth anniversary of the Aviation Engineers of the Army Air Forces. Called upon to perform prodigious feats of construction in the building of airports for the use of our Fighting Forces in many theaters of the war, the Aviation Engineers have made it possible to bring our airplanes closer and closer to the enemy as one position after another has been cleared and held in the advances made toward the objectives. In some instances, such as Burma, these airports were constructed behind enemy lines under conditions which frequently required fighting off attacks threatening the work.

Most mechanical engineers serving aviation during the war have been engaged in research, design, and production in factories producing planes, engines, and accessories. The products which came from their production lines would have been of little value had it not been for the work of the Aviation Engineers in providing the airstrips and airfields in Africa, Italy, France, and the islands of the Pacific which fighting and transport aircraft use as landing fields, where they could be refueled and serviced, and to which victorious crews could return after their missions. To the Aviation Engineers of the Army Air Forces their brother engineers offer congratulations and a prayer of thanks on their fifth anniversary.

DIAMOND CUTTING TOOLS

By PAUL GRODZINSKI

MANAGER, RESEARCH DEPARTMENT, THE DIAMOND TRADING COMPANY, LTD., LONDON, ENGLAND

EARLY USES OF DIAMOND CUTTING

THE use of the shaped diamond tool for cutting both metals and nonmetallic materials is frequently considered as quite new; its first application is said to have been that for engine production during the first world war.

Articles on this subject first appeared in technical papers about 1924, but the value of the diamond as a cutting tool was not appreciated nor did it come into wide general use outside America until 1930. A common belief, and one formerly also held by the author, is that diamond turning tools were not used for metals before the "nineties," and for nonmetallic materials not before the "seventies." Historical studies (1)[1] recently carried out, however, reveal that diamond tools were in fact used for turning hardened steel by one Jesse Ramsden before 1779, that soft metals, such as brass, were turned with the diamond before 1827, andthat nonmetallic materials, such as paper calender rolls, were first turned with diamond tools in 1858.

The two last-mentioned groups of materials are those on which it is recommended to use the diamond tool today, but modern diamond-tool manufacturers and users view with concern the statement that hardened steel can be machined with the diamond. The author feels that the data should be carefully checked and that tests should be carried out to determine whether or not the diamond may be usefully employed for such purposes. It may be mentioned that Ramsden's usage of diamond tools for this purpose is not the only reference in the early literature to the use of diamond tools for machining hardened steel.

PRESENT-DAY APPLICATION

Shaped diamond tools are used at the present time for obtaining finely finished sliding and rotating parts. Indeed, surfaces with h_{avg} or h_{rms} down to 1 microin. (which may correspond to h_{max} of 4 to 5 microin.) have been produced with them (2). This does not mean, however, that such fine surfaces are necessary in every case. Fig. 1 shows graphically some results which have been obtained by W. E. R. Clay (3) of Rolls Royce, Limited, with shafts of various surface finishes and a bearing surface of h_{avg} 18 to 20 microinches. According to the hydrodynamic theory, it can be assumed that the surface finish of the bearing has the same effect as the surface finish of the journal. Hence the same relationship may hold good for a journal with a surface roughness of 18 to 20 microinches in contact with bearings of different degrees of finish, which would demonstrate the higher loadability of diamond-finished bearings. Actually, tests carried out by Lehr (4) on plastic bearings some years ago gave higher loadability factors than those recorded by other investigators, and this was probably due to the diamond finishing of the bearings used by Lehr.

The materials, on which diamond tools are used at the present time, range from metals and alloys to nonmetallic substances, such as carbon and plastics (see Table 1), all of which are particularly abrasive on the cutting edges of high-speed-steel and sintered-carbide tools.

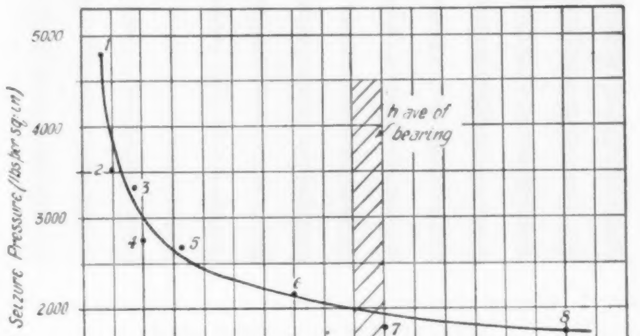


FIG. 1 INFLUENCE OF SURFACE FINISH ON INCIPIENT SEIZING PRESSURE

(1 Fine-lapped, 2 superfinished, 3 ultrafine ground, 4 lapped, 5 fine ground, 6 medium ground, 7 rough ground, 8 rough ground and polished. Buick process; according to W. E. R. Clay, ref. 3.)

TABLE 1 METALLIC AND NONMETALLIC MATERIALS WHICH CAN BE MACHINED[a] WITH POLISHED DIAMONDS

Material	Application
Light metals	Aluminum, magnesium alloys, duralumin, alusil, etc.
Soft metals	Copper, brass
Bearing metals	Babbitt metal, bronze
Precious metals	Silver, gold, platinum
Cast iron and steel	(In special cases)
Soft rubber	(For instance, platens for typewriters and rolls for printing machines)
Hard rubber	(Ebonite; in fountain pens, for instance)
Plastic materials	(Phenol formaldehyde, urea resins, cellulose acetate, etc.)
Compressed graphite	(For instance, electrodes)
Composite materials	(For instance, paper calender rolls)

[a] Turning, boring, milling.

FUNDAMENTALS OF DIAMOND AS A CUTTING MATERIAL

The diamond is a naturally occurring mineral, consisting of carbon crystallized in the cubic system. Bragg and Bragg (5) found in 1913 that the structure of the diamond is face-centered cubic and that every carbon atom is at the center of gravity of four others. The only other structure of close packing is hexagonal close packing. From such a perfectly crystalline structure one may expect unusual physical properties, and as a matter of fact, the diamond does possess extraordinary physical characteristics, such as extremely low compressibility, high Young's modulus, great resistance to abrasion, and great breaking strength (6). High heat conductivity, high melting point. and chemical inertness are further properties worth mentioning,

Some of these properties have proved to be very valuable in practice, but as yet scientific proof is lacking as to how these properties vary (*a*) within the diamond substance; (*b*) with different diamonds from the same source; and (*c*) with diamonds of different origin (7). There is sufficient general evidence that the variations (*b*) and (*c*) are considerable but as far as the author is aware, precise scientific tests on this point are only just commencing. With reference to (*a*), it is common knowledge

[1] Numbers in parentheses refer to list of references at the end of the paper.

Contributed by the Research Committee on Metal Cutting and presented at the Annual Meeting, New York, N. Y., November 27–December 1, 1944, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

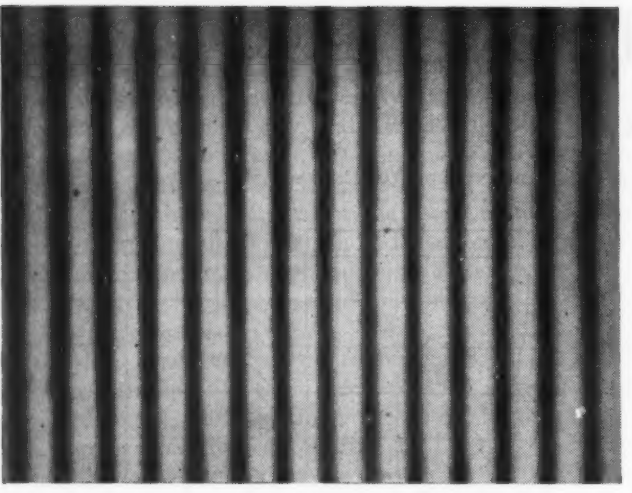


FIG. 2 INTERFEROGRAM OF A POLISHED DIAMOND SURFACE SUCH AS ARE PRESENT IN DIAMOND TOOLS

(The distance between the black and white lines is about 0.3 micron, and a surface roughness would show waviness or interruption of the black lines; ×80. Illustration supplied by J. F. Kayser.)

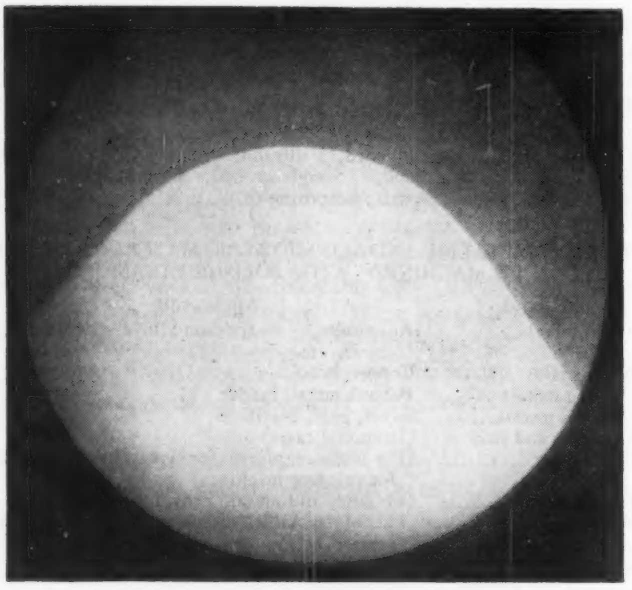


FIG. 3 PHOTOMICROGRAPH OF A GOOD DIAMOND-TOOL EDGE; ×52

that the structure of the diamond crystal has to be taken into account in the production of certain cutting tools, but even in this case no generally accepted theory exists, and no actual proof has yet been brought forward as to which is the best or most economical orientation of the diamond crystal when used in the form of a cutting edge. The fundamental basis of all this may perhaps be brought to light by certain investigations which are contemplated, and which may explain why diamonds could formerly be used for cutting hardened steel, while today this usage is regarded as almost impossible.

The cutting process may be considered first. In ordinary cutting on the lathe, the wedge of the tool, as seen in a plane perpendicular to the leading edge, rolls off a chip, which according to the cutting conditions is either continuous or interrupted (8). Since the chip is in contact with the rake surface of the tool over some distance, the resulting cutting force does not act directly at the tool edge, but some distance away from it. This is revealed by the formation of a built-up edge near to the actual tool edge which does not disappear during cutting. In this way the built-up edge actually protects the cutting edge, an effect which is aimed at by the use of artificial means such as Klopstock's cutting edge and by chip-breaker grooves, although the latter are mainly for the purpose expressed in their name. It has been shown that this built-up edge can be avoided by increasing the cutting speed. The cutting speed, however, is inversely proportional to the life of the tool edge, or even to the *n*th power of its life, *n* varying from 1 to 8 for ordinary tool materials. Thus from the point of view of economy, the cutting speed has a limit for a given tool material, and of course, for the material to be machined. If, however, the tool material can be improved or a more resistant tool material be found, the cutting speed could be still further increased, since the resultant of the cutting forces can then act much nearer to the cutting edge.

How near to the cutting edge the resultant of the cutting forces is situated also depends upon the thickness of the chip; the thinner the chip the nearer the pressure to the edge. Hence since high speed and fine depth of cut are essential in finishing operations, it follows that it is necessary to use an exceptionally good cutting material, and such a material is available in a correctly selected, orientated, and machined diamond.

The surfaces of the diamond are extremely smooth, actual measurements indicating a surface roughness of less than h_{avg} = 1 microin., while interferograms, Fig. 2, suggest a still better surface like that of an optical flat (9). The cutting edge, Fig. 3, is supposed to show an absolutely clean edge at a magnification of at least 100 times, and no chips should be present. The lenses commonly used in workshops give magnifications of up to 10 times and are, therefore, unsuitable for this purpose. The smoothness of the surface has a direct bearing on the cutting process for, as has recently been shown by Merchant (10), in the case of most materials normally machined with diamonds, both the coefficient of friction between tool and chip and the cutting pressure are sensibly reduced, when the tool surfaces are highly polished.

The absolute value of the cutting force is very low and is usually in the range of 2 to 4 lb but, with reference to the actual area, the specific cutting pressure is extremely high, say up to 500,000 psi (11).

In order to obtain an approximate idea of the efficiency of diamond-cutting without making laboratory tests, the author's recommendation is to calculate the cutting path, i.e., the length of path the cutting edge has performed before it became blunted. This seems to be more conclusive than just to count the number of workpieces produced. It can be shown that the cutting path L is equal to the product $T \cdot v$, with T cutting time, and v cutting speed. This corresponds to the usual cutting law with the exponent $n = 1$, and it could be shown from data represented in literature that exponents n near 1 have already been found in particular when machining aluminum; therefore a general assumption of this kind may not be far out (12). Usual data are 1500 to 2000 miles cutting path for faceted diamond tools.

It would be most useful if the presumptions and data given in this section could be carefully checked by modern investigation methods. The author knows of only three research establishments which have shown interest in the testing of shaped diamond tools, and he has been seeking experimental data for more than 15 years.

CUTTING-TOOL NOMENCLATURE

A nomenclature for single-point cutting tools has been accepted in America, but, unfortunately, no standard symbols have been fixed. Hence when the author decided to deal with this problem from a geometrical viewpoint, he decided to use the designations not only employed in German and Swiss standards but also suggested with some modifications by G. Schlesinger as a British standard. It may perhaps be mentioned that, even in 1928, the author introduced the designation κ_2 for the back-adjusting angle and κ_1 for the front adjusting angle,

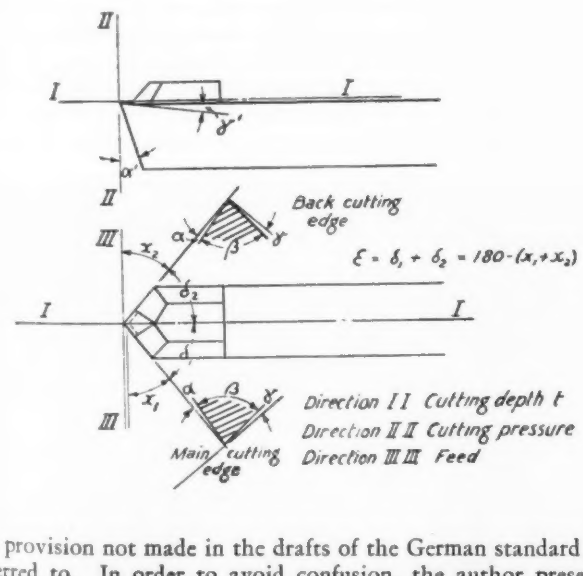
TABLE 2 COMPARISON OF NAMES FOR CUTTING ANGLES[a]

1 Proposal for adjustable-tool edges	2 G. Schlesinger, 1942	3 A.S.M.E. 1940	4 Manchester, 1928	5 German standard DIN 768.2	6 Swiss standard — German	6 Swiss standard — French
Perpendicular to Cutting Edge:						
α Clearance						
α_r Real clearance	α Clearance angle	Working relief angle (side clearance)		α Freiwinkel	α Anstellwinkel	α Angle de dépouille
γ Rake, γ_r real rake	γ Top rake angle	True rake angle	True top rake	γ Spanwinkel	γ Spanwinkel	γ Angle d'attaque
β Wedge angle	β Tool angle	Lip angle		β Keilwinkel	β Keilwinkel	β Angle de tranchant
	δ Real cutting angle	Cutting angle	True cutting angle	δ Schnittwinkel	δ Schnittwinkel	δ Angle de coupe
Plan View:						
ϵ Point angle	ϵ Angle of point	Nose angle	Included nose angle plan angle	ϵ Spitzenwinkel	ϵ Spitzenwinkel	ϵ Angle de bec
κ_1 Front adjusting angle	κ_1 Cutting angle in plan			κ Einstellwinkel	κ Einstellwinkel	κ Angle de direction
κ_2 Back adjusting angle	κ_2 Back setting angle	End cutting-edge angle	Horizontal front clearance			
$\delta_1 = 90 - \kappa_1$ angle between leading cutting edge and center line of tool		Side cutting-edge angle (shear angle)	Rake angle (approximately)			
$\delta_2 = 90 - \kappa_2$ angle between rear edge and center line of tool						
Side View:						
α' Front or top clearance angle	α_1 Front clearance angle	End relief angle and clearance angle (front clearance)	Front clearance			
γ' Back rake angle		Back rake	Front top rake or back slope			
β' Point wedge angle						
Section:						
α'' Clearance angle	α_2 Side clearance angle	Side relief angle	Side clearance			
γ'' Rake angle		Side rake angle	Side top rake or side slope			
β'' Wedge angle			Side cutting angle	Neigungswinkel	Neigungswinkel	Obliquité du tranchant
Inclination of Cutting Edge:						
	λ Back rake angle	Back relief angle		λ Neigungswinkel	λ Neigungswinkel	λ Obliquité du tranchant
					τ Hinterschliffwinkel	τ Dépouille laterale
					η Unterschliffwinkel	η Dépouille vers la base

[a] Perpendicular to cutting edge.

COMMON RELATIONS

$$\alpha + \beta + \gamma = 90^\circ \qquad \tan\alpha' = \tan\alpha . \sec\kappa_1$$
$$\alpha' + \beta' + \gamma' = 90^\circ \qquad \tan\gamma' = \tan\gamma . \mathrm{cosec}\,\kappa_1$$
$$\alpha'' + \beta'' + \gamma'' = 90^\circ \qquad \tan\alpha'' = \tan\alpha . \mathrm{cosec}\,\kappa_1$$
$$+ \kappa_1 + \kappa_2 = 180^\circ \qquad \tan\gamma'' = \tan\gamma . \sec\kappa_1$$
$$\delta_1 + \delta_2 = \epsilon$$



REFERENCES

1 Proposal to be issued by *Industrial Diamond Review*, referring to adjustable-tool edges (19).

2 "Proposal for British Nomenclature," by G. Schlesinger, *Journal*, Institution of Production Engineers, vol. 21, 1942, p. 75.

3 "Nomenclature for Single-Point Cutting Tools," American Standards Association, sponsored by S.A.E. and A.S.M.E.

4 Lathe Tools Research Committee, The Manchester Association of Engineers, December, 1928; see also, "Cutting Tool Nomenclature," by J. Rennie, *Machinery*, vol. 64 (June 15), 1944, pp. 655–657.

5 German Standard DIN 768.2, issued October, 1930.

6 Swiss Standard VSM 34111, issued December, 1933.

a provision not made in the drafts of the German standard referred to. In order to avoid confusion, the author presents Table 2, which gives a comparison of the standards with the proposals made here. Special care has been taken to give the angles between faces, as these are needed not only by the diamond polisher but by every toolmaker. Unfortunately draftsmen usually prefer to give angles as seen in the usual projections, but these are of no help to the toolmaker.

PLANE OF CHIP FLOW

When considering cutting conditions for surface-finishing operations, the problem should be considered from the plane of chip flow, Fig. 4, that is, from a plane which is perpendicular to the leading edge. This point has not always been fully appreciated in the past and has led to misunderstanding in certain cutting problems. When the leading cutting edge is inclined at an angle to the work, it generates an inclined helix, but, ow-

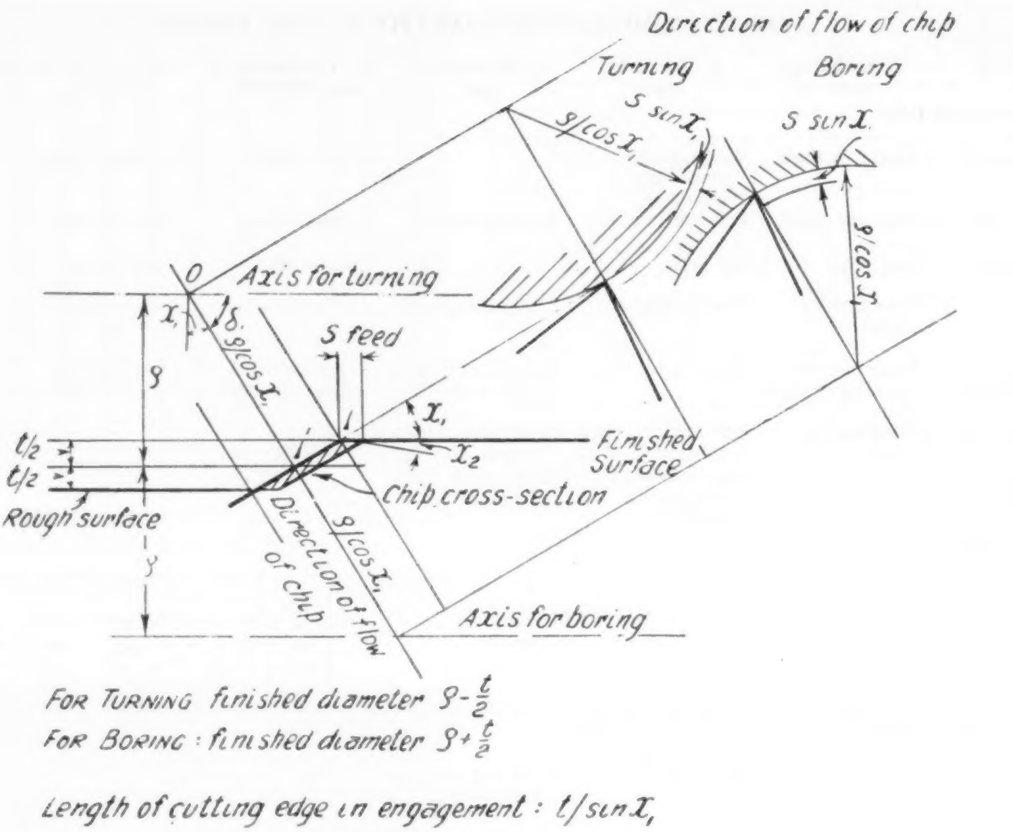


FIG. 4 PLANE OF CHIP FLOW

ing to the very small feeds used in finishing operations, this may be considered as a cone. The plane of chip flow therefore intersects the workpiece in a conic section, usually an ellipse; the only dimension of this ellipse which is of importance is the radius of curvature which it represents toward the tool edge. This is equal to that of the sphere inscribed in the cone, thus $R = 1'0 = \rho/\cos\kappa_1, = \rho.\sec\kappa_1$, Fig. 4, where ρ is the radius of the workpiece at its intersection with the plane of chip flow. The plane of chip flow can assume several probable positions; for instance, it may be located at the center of gravity of the chip, but for fine chips it may suffice to locate it halfway between rough and finished surface. The same diagram is valid for both external and internal turning, the latter usually being called boring. The thickness of the chip in the plane of flow of chip is $s \cdot \cos\delta_1 = \pm s \cdot \sin\kappa_1$.

SELECTION AND ORIENTATION OF DIAMOND

Since the diamond belongs to the cubic system, it has three possible different orientations of faces as follows:

Crystallographic designation	Designation of diamond cutter	Face of
(100)	Four-point	Cube
(110)	Two-point	Dodecahedron
(111)	Three-point	Octahedron

In addition to these, of course, intermediate positions are possible for a tool face (table). Furthermore, the cutting edges may be located in various directions in these planes. It follows, therefore, that in a finished tool it is difficult to find out which orientation has been employed, but modern X-ray methods (13) allow this to be determined quite easily. Wooden models, Fig. 5, of the tools in question may also be made, and, following a suggestion of Dr. Wooster, the cleavage planes may be indicated by saw cuts. Then with the aid of models of wood or of transparent plastics and of octahedron and tetrahedron shape, Figs. 6(*a*) and 6(*b*), the approximate orientation can be demonstrated to user and manufacturer.

Hitherto, in the literature only two favorable orientations for cutting tools have been described; (*a*) cutting edge along the major diagonal of a dodecahedron face (14), and (*b*) one around the corner of the cube face (15). From what is already known of the diamond as a substance, these two forms are based upon opposing principles, so that differences may be expected in practice. Some research work on this subject is being undertaken at the present time therefore by the research department of the Institution of Production Engineers, Loughborough, in collaboration with the research department of the author's company. In these tests, diamond tools with the same shaped cutting edge, but differently orientated with respect to the diamond

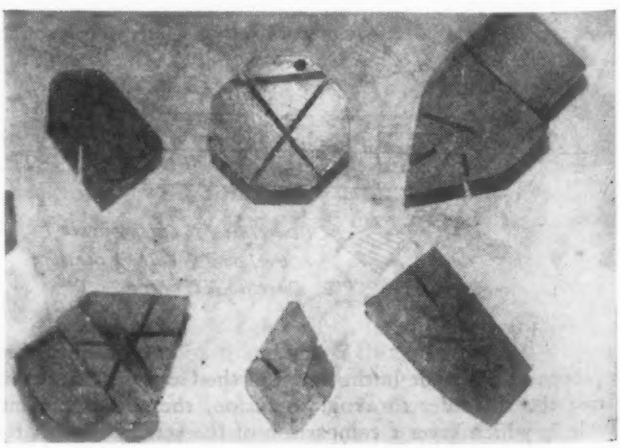


FIG. 5 WOODEN MODELS OF DIAMOND CUTTING TOOLS TO SHOW CRYSTAL ORIENTATION
(Saw cuts in model show cleavage planes.)

crystal, Fig. 7, are being used. Each has the actual cutting edge in a different direction in the three main orientations, cube face, dodecahedron face, and octahedron face, making a total of six tools and each of these six tools has been duplicated by another manufacturer.

OPTIMUM TOOL SHAPE

It is necessary to distinguish between tool edges for obtaining optimum surface finish and those for producing special contours, since there has been a tendency to combine these characteristics so as to produce a universal tool edge. Needless to say, this can be obtained only by sacrificing surface finish.

The most appropriate tool form for finishing straight cylindrical or plane surfaces is a tool edge with a front adjusting angle of 30 to 45 deg, and a back adjusting angle of 0 to 2 deg. Such a tool form was probably first used in America by the Coulter Machine Company (16), and by the Bausch & Lomb Optical Company (17). It is also in general use in Germany, but only recently has it been found out experimentally in England that a tool edge of this type, with a small radius at the intersection of its two faces, Fig. 8, produces the finest surfaces (2). The back cutting edge smooths or burnishes the finished surface, which is facilitated by a small clearance angle between finished surface and tool edge. This tool form leads to a large tool-point angle of between 135 and 170 deg. Investigations to correlate the theoretical profile height, as calculated from the tool shape and the rate of feed with measured values, have not as yet led to any practical results. If this is achieved, it will be possible to preselect the most suitable tool edge for a given material and any given set of working conditions. Some

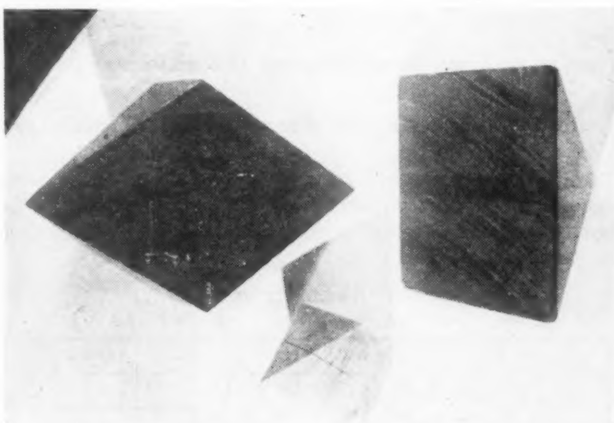


FIG. 6(*a*) WOODEN MODELS USED TO IDENTIFY ORIENTATION OF TOOL MODELS, FIG. 5, WITH REFERENCE TO PRIMITIVE ORIENTATION OF DIAMOND CRYSTAL

(Diamond pyramids with cube face 100; and dodecahedron face 110.)

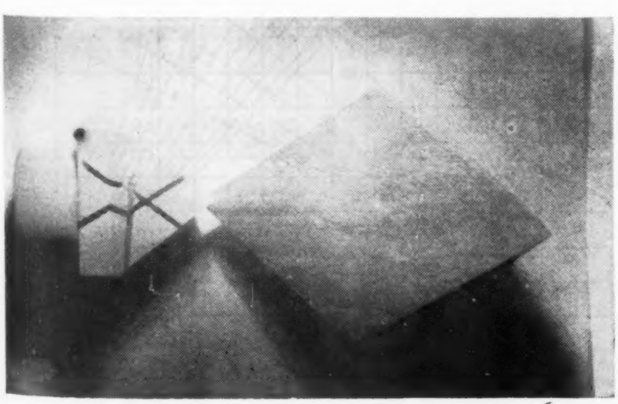


FIG. 6(*b*) HOW MODELS OF FIG. 6(*a*) ARE USED

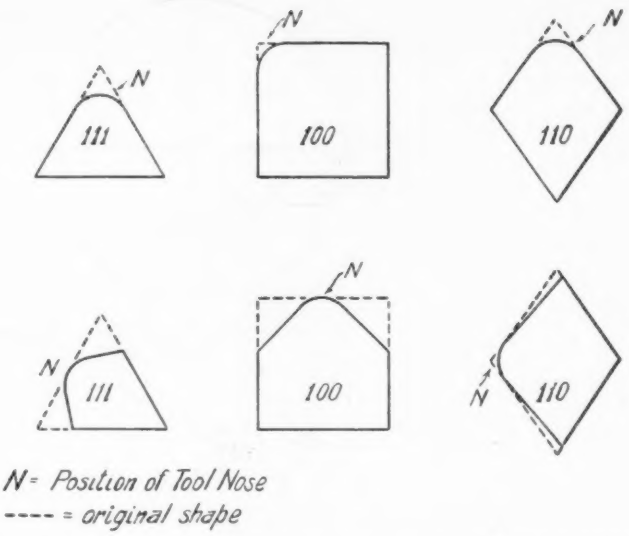


FIG. 7 SIX POSSIBLE ORIENTATIONS OF DIAMOND-TOOL EDGES WITH REFERENCE TO THE THREE BASIC PLANES IN THE CUBIC CRYSTAL, 100 CUBE, 110 DODECAHEDRON, 111 OCTAHEDRON

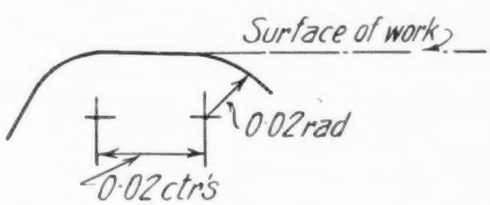


FIG. 8 DIAMOND-TOOL EDGE WHICH PRODUCED HITHERTO FINEST SURFACES

(Surface finish produced on aluminum less than 1 microinch blended facet tool of British Precision Diamond Tools, Ltd.)

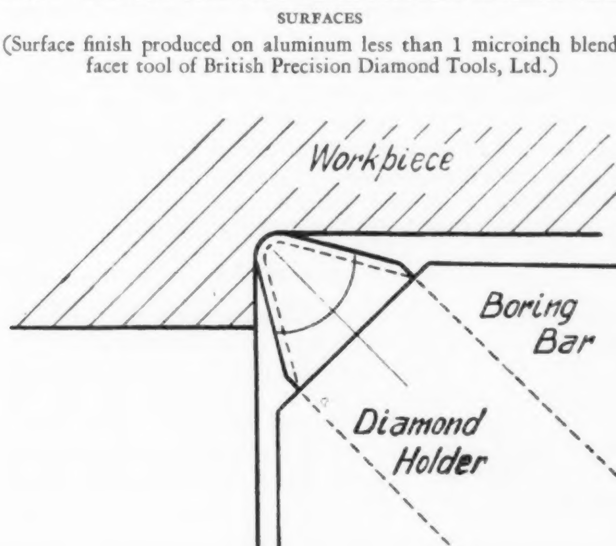


FIG. 9 DIAMOND EDGE OF BORING TOOL LIMITED TO SMALL RADIUS AND ABOUT 80 DEG INCLUDED ANGLE

(When stepped bores have to be machined this limitation results in some sacrifice in surface finish produced.)

modern tool edges of course are so shaped that theoretically no resulting surface roughness can be expected. A necessary presumption for a high surface finish is of course that the machine runs at a speed which causes a minimum of vibrations.

Other tool forms have to be selected primarily according to the surface which it is desired to produce. For instance, in the case of stepped holes and collars, a tool point with an included angle larger than 90 deg cannot be used, a common

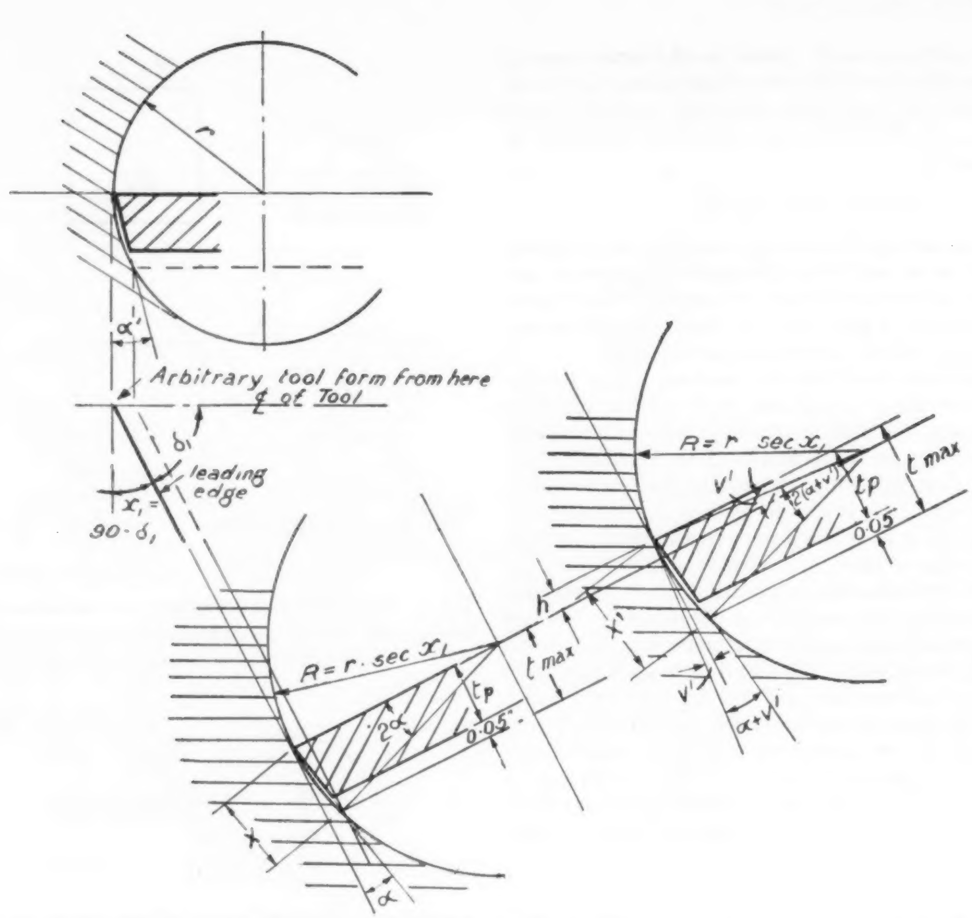


FIG. 10 BORING TOOLS REQUIRE GREATER CLEARANCE ANGLES IN RELATION TO TIP THICKNESS AND DIAMETER

practice being to select angles of about 80 deg, Fig. 9 (18). Similar instances are grooving and cutting-off tools, thread-cutting tools, and the like, and for these sufficient clearance angles have to be allowed. In the case of boring tools, additional clearance is necessary for accommodating the tool in the cylindrical hole produced. The following relationship for the maximum possible tool tip thickness has been found, Fig. 10:

$$t = r \cdot \sec \kappa_1 \sin 2\alpha \ldots\ldots\ldots\ldots\ldots\ldots [1]$$

This links up the angle κ_1 with the clearance angle and the thickness of the tool tip for machining a given diameter of $d = 2r$. The chart, Fig. 11, allows a suitable tool tip to be easily found where there is a clearance of 0.05 in. between the tool and the hole. If a tool tip of the indicated dimension cannot be accommodated, a so-called secondary clearance has to be provided (19). The additional clearance also reduces to a slight degree the surface finish obtainable.

SETTING OF THE DIAMOND

While it was formerly usual to machine only the actual tool edges which perform the work, it was subsequently found that better settings could be provided when additional faces of the tool body were machined. When excessive heat is excluded from the tool edge and the setting subject to careful inspection, brazing may perhaps still represent a very suitable way of setting diamonds. In this connection, the application of radiology, Figs. 12(*a*), 12(*b*), and 13 (20), as used in both England and in America may be recommended.[2] The same methods allow inspection of cold-set diamond tools (21). In the opinion of the author, cold-set diamond tools are superior because of (*a*) elimination of heat; (*b*) ease of removal; and (*c*) possibility of correct relapping.

Another possible setting method, but one which does not seem to have been employed as yet, is that of sintering diamonds firmly in a metallic matrix and then polishing them.

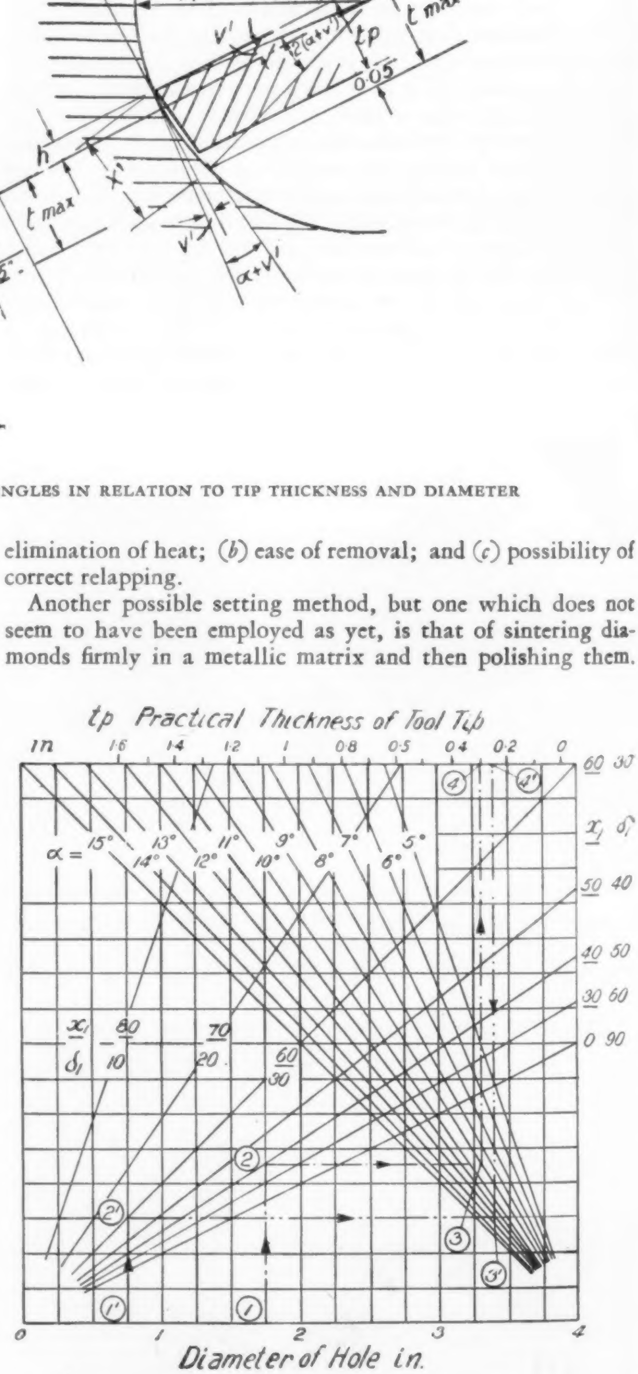


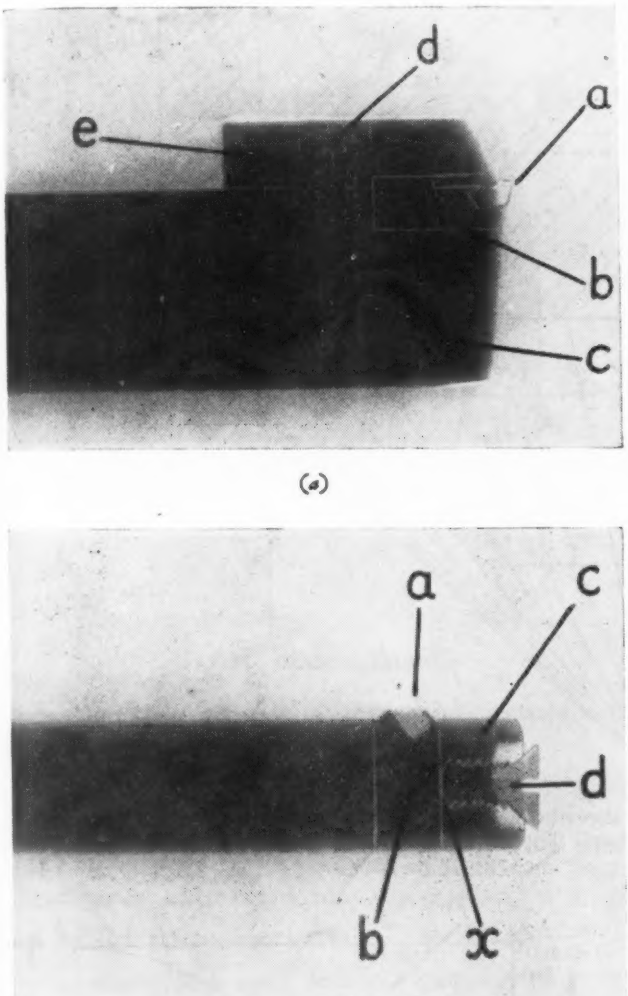
FIG. 11 NOMOGRAM FOR DETERMINING MAXIMUM PERMISSIBLE TIP THICKNESS OF DIAMOND BORING TOOLS

[2] It will be noted, however, that the reproductions of radiographs in this paper are lacking in a certain amount of detail which exists in the original negative. It is, of course, the usual practice to refer to the negative in X-ray work; positive prints are never used in diagnosis.

A cold-setting method by using the contours of the rough diamond as a die has recently been made known.

ANGULAR ADJUSTMENT OF DIAMOND TOOLS

The advantages of diamond tool tips, that is to say, long life, extremely smooth cutting edges, and low cutting pressure, are accompanied by the disadvantage that the actual tool shape cannot easily be changed. With all other tool edges, the skill of the operator consists in his ability to grind his tool edge correctly but, with diamonds, only the adjustment of the tool can be changed in order to obtain optimum results.



(*a*)

(*b*)

FIG. 12 RADIOGRAPHS OF DIAMOND TOOLS; EXAMPLES BY E. J. TUNNICLIFFE

(*a*, Diamond brazed in; *b*, socket or shank; *c*, boring bar or tool holder; *d*, clamping screw; *x*, end of clamping screw pressing directly on tool shank.)

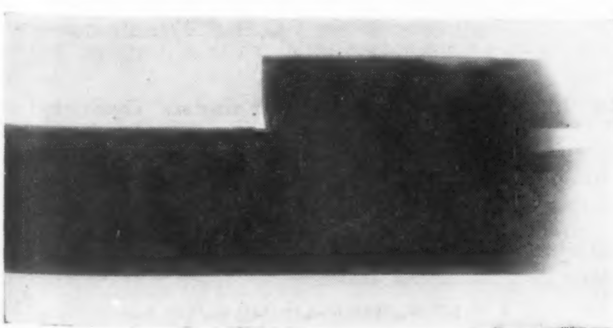


FIG. 13 RADIOGRAPH OF COLD-SET DIAMOND TOOL

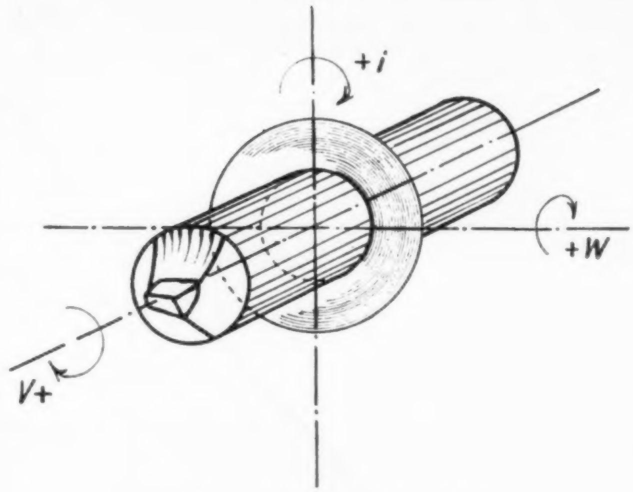


FIG. 14 DIRECTIONS OF ADJUSTMENT

The need and the importance of the correct adjustment of diamond-tool edges has long been recognized and proved by experiment. For instance, the effect of a small back-adjusting angle κ_2 and the rotation of boring tools about their central axes are means well known to the users of diamond tools (22). Lathes are usually provided with special means for adjusting the tool with reference to a vertical axis. Means are also necessary for insuring the adjustment to center height or slightly above it. In addition, special tools have recently been developed which allow the cutting edge to be adjusted universally with regard to the workpiece (23).

When handling such tools, the skill of the operator is in the correct adjustment of the tool edge for optimum results. This method, however, is not intended to "give the correct tool angles" for a variety of materials and cutting conditions, as this is essentially a field for experiments and practical trials. Some mathematical and graphical methods which the author believes to be entirely new will be given for determining the real clearance and rake angles, that is to say, the angles in the plane of the chip flow for adjustable-tool edges. Thus, when the angles which give optimum results are known, the mathematical and graphical methods presented here will enable the adjustment and maintenance of such angles to be made with the minimum of effort. The limitations of a given tool adjustment can be determined without trials which would perhaps be dangerous to the sensitive cutting edge of a diamond.

By the time optimum cutting conditions have been determined with an adjustable-tool edge, it will already have lost the very effect which is being sought, and in production, the fixed-type tool should be applied. The author believes that the field of application of the adjustable tool is in research, in preliminary tests on new materials, and in production problems.

The universally adjustable tool has three directions of adjustment, Fig. 14:

1 About a horizontal axis, usually coinciding with the axis of the tool shank (angle $\pm v$).

2 About vertical axis (angle $\pm i$).

3 About a horizontal axis, usually perpendicular to the shank axis (angle $\pm w$).

If we assume that in the original position, the rake surface of the tool coincides with the x,y-plane of a co-ordinate system and that this plane is then rotated first about the y axis at an angle w, then about the x axis at an angle v, and finally about the z axis at an angle i, it can be shown that a rake angle γ_r is obtained; thus

$$\tan\,\gamma_r = \tan w \cdot \sin\,(\delta_1 - i) + \tan v \cdot \cos\,(\delta_1 - i) \quad \ldots [2]$$

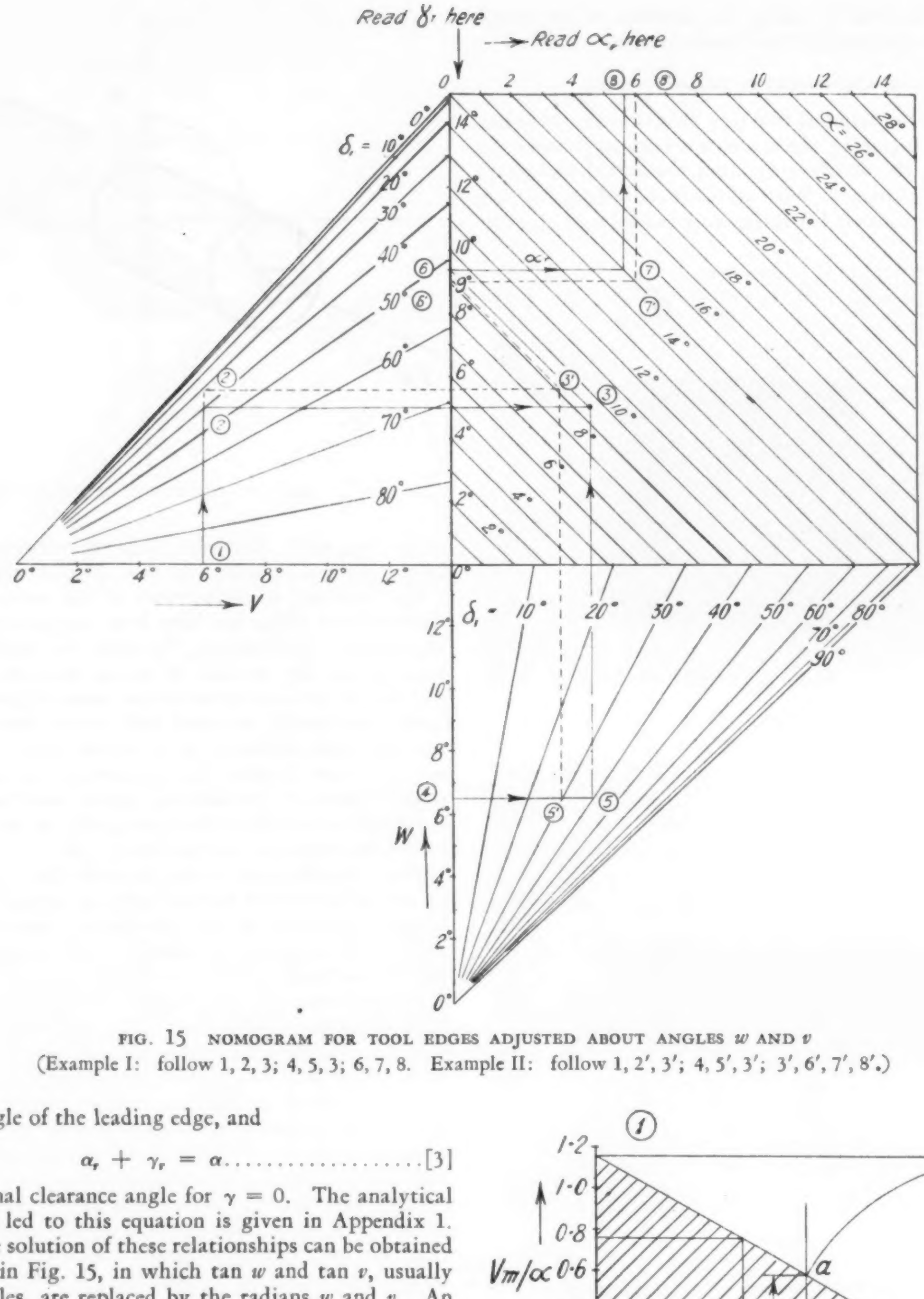


FIG. 15 NOMOGRAM FOR TOOL EDGES ADJUSTED ABOUT ANGLES w AND v

(Example I: follow 1, 2, 3; 4, 5, 3; 6, 7, 8. Example II: follow 1, 2′, 3′; 4, 5′, 3′; 3′, 6′, 7′, 8′.)

where δ_1 = angle of the leading edge, and

$$\alpha_r + \gamma_r = \alpha \qquad [3]$$

being the original clearance angle for $\gamma = 0$. The analytical solution which led to this equation is given in Appendix 1. An approximate solution of these relationships can be obtained graphically, as in Fig. 15, in which tan w and tan v, usually quite small angles, are replaced by the radians w and v. An example is sketched in for $v = 6°$, $w = 7°30'$, $\delta_1 - i = 40°$, and $\alpha = 15°$, which gives $\alpha_r = 5°30'$ and $\gamma_r = 9°30'$. Furthermore, when the angle of the leading edge ($\delta_1 - i$) is changed to 30°, then $\alpha_r = 6°$ and $\gamma_r = 9°$. The same diagram can also be used when one or two of the three angles v, w, and i become zero, but for practical purposes it may be more useful to employ simplified nomograms.

The limit for this adjustment is reached when $\alpha_r = 0$, in other words, when the clearance face rubs against the surface of the workpiece. It is obvious that in this case $\gamma_{r\max} = \alpha$, and that the maximum adjustability of the edge is governed by the relationship

$$\tan \alpha = \tan w_m \cdot \sin(\delta_1 - i) + \tan v_m \cdot \cos(\delta_1 - i) \qquad [2a]$$

in which w_m and v_m can assume various values. For the limit cases $w_m = 0$ and $v_m = 0$, we obtain

$$\tan v_{m0} = \frac{\tan \alpha}{\cos(\delta_1 - i)} \qquad [4a]$$

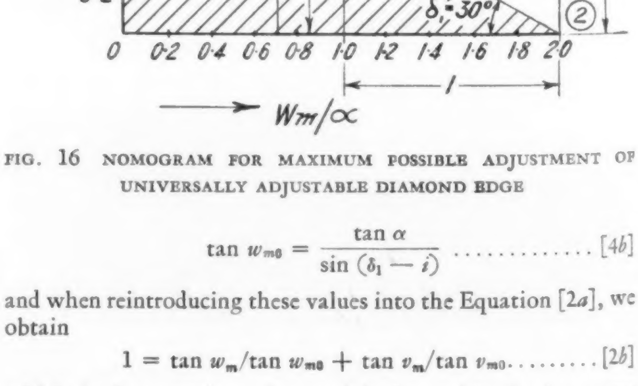


FIG. 16 NOMOGRAM FOR MAXIMUM POSSIBLE ADJUSTMENT OF UNIVERSALLY ADJUSTABLE DIAMOND EDGE

$$\tan w_{m0} = \frac{\tan \alpha}{\sin(\delta_1 - i)} \qquad [4b]$$

and when reintroducing these values into the Equation [2a], we obtain

$$1 = \tan w_m / \tan w_{m0} + \tan v_m / \tan v_{m0} \qquad [2b]$$

which is the equation of a straight line with the intercepts tan w_{m0} for the tan w_m axis and tan v_{m0} for the tan v_m axis.

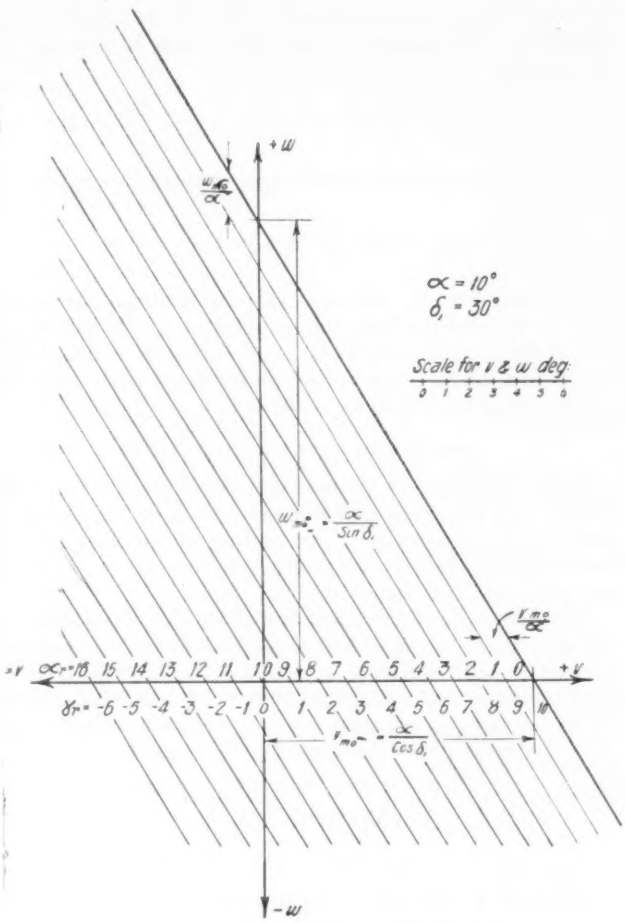


FIG. 17 GENERAL DIAGRAM

Since the tangent can again be approximately replaced by the radian, we obtain

$$1 = w_m/w_{m0} + v_m/v_{m0} \text{ (nomogram, Fig. 16)}$$

It is obvious that the values v_{m0} and w_{m0} indicate the limits only for co-ordinated positive values of v_m and w_m, and that to give an example for $-w_m$, $v_m > v_{m0}$, hence there is no limit to the adjustment where both w and v are negative, Fig. 17. In this diagram, the distances $w_{m0} = \dfrac{\alpha}{\sin \delta_1}$ and $v_{m0} = \dfrac{\alpha}{\cos \delta_1}$ are further subdivided α equal parts and connected by straight lines having in the v direction a distance $v_{m0}/\alpha = \dfrac{1}{\cos \delta_1}$ and, in the w-direction, a distance $w_{m0}/\alpha = \dfrac{1}{\sin \delta_1}$; these lines give variable values α_r and γ_r, as can be shown by simple analytical geometry. The diagram in Fig. 17 also permits the solution of the opposite problem, that is, which adjustments i, w, and v are necessary to obtain a definite true rake angle γ_r. It is obvious that this is possible by selecting at random two adjusting angles, say i and, w, and then finding the angle v from the diagram.

The nomograms, Figs. 16 and 17, may be constructed without calculation by observing that $v_{m0}/w_{m0} = \tan(\delta_1 - i)$, hence the included angle $10/02 = \delta_1$. Proceeding from 2 where $k = \tan \delta_1$, a point a is obtained, and transferring the length $2a$ to $2b$ and making $01 = 2b$, the point a is arrived at. This leads to a further nomogram for various values of $(\delta_1 - i)$ with the co-ordinates w_m/α and v_m/α, Fig. 18. The inclined lines for $(\delta_1 - i)$ include with the abscissa the corresponding angles; all lines are tangents to a circle of radius $r = 1$.

The same relationship can be used for finding the adjustment of back cutting edges and for faceted and radiused tool edges.

In the latter case, Fig. 19, the angle δ_1 at which the tool edge enters the workpiece has first to be considered, followed by a study of the changes which take place continuously up to 90 deg. Where r is the radius of the tool edge and t, the depth of cut, the entering angle is

$$\delta_1 = \sin^{-1}\left(1 - \frac{t}{r}\right)$$

For checking such adjustment the author has recently developed a wooden model for experimental purposes, Fig. 20,

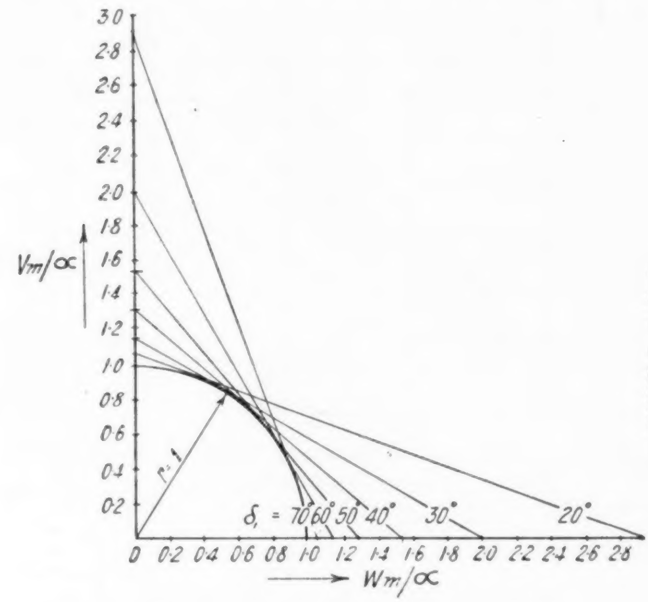


FIG. 18 DIAGRAM SHOWING INFLUENCE OF ANGLE OF LEADING EDGE ON MAXIMUM ADJUSTABILITY

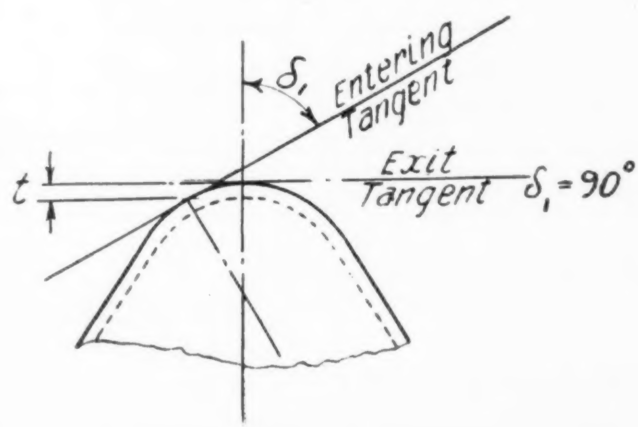


FIG. 19 RELATION FOR CURVED CUTTING EDGE

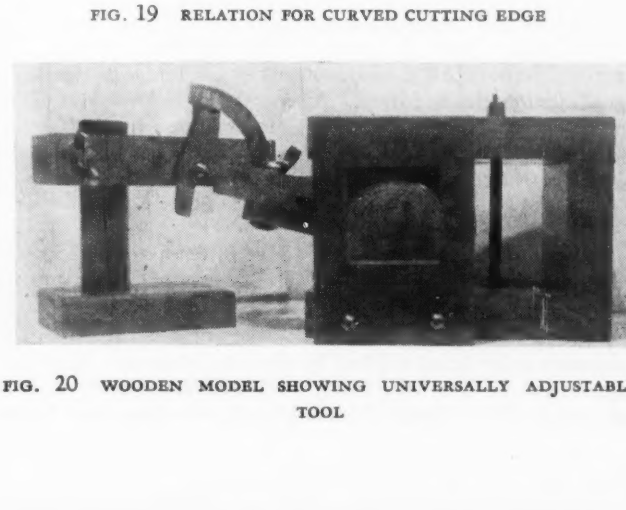


FIG. 20 WOODEN MODEL SHOWING UNIVERSALLY ADJUSTABLE TOOL

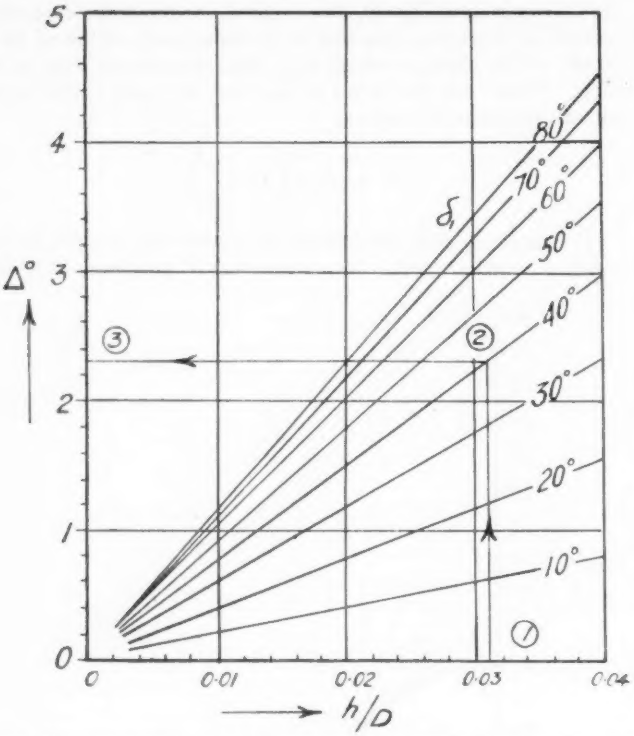


FIG. 21 NOMOGRAM FOR INFLUENCE OF HEIGHT ADJUSTMENT OF CUTTING TOOLS

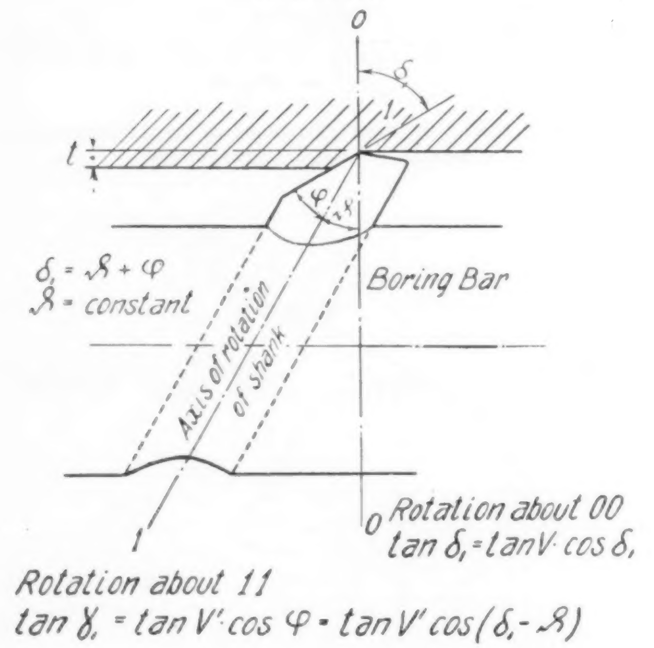


FIG. 22 BORING-BAR INSERT WITH INCLINED AXIS

which illustrates all the adjustments of i, v, and w by a series of graduated circles and lines. A separate device was also developed for measuring these angles. In practice an optical device for measuring the angles in production and control of diamond tools is strongly recommended.

HEIGHT ADJUSTMENT

When a tool edge is adjusted above or below the center line without changing the direction of the tool holder, the cutting angles are necessarily changed. When adjusting above center height in turning operations, the rake angle is increased, the clearance angle being reduced by the same amount. In boring operations, on the other hand, precisely the opposite effect is obtained. With diamond cutting tools, an adjustment below the center line is not recommended either for turning or boring operations. The change in the angle Δ can be expressed by the formula

$$\sin \Delta = \frac{h}{R} = \frac{h}{\rho} \cdot \cos \kappa_1 = \frac{2h}{d} \cos \kappa_1 = \frac{2h}{d} \cdot \sin \delta_1$$

Since Δ is usually a very small angle, this can be written

$$\Delta \text{ deg} = 115 \cdot \frac{h}{d} \cos \kappa_1 = 115 \frac{h}{d} \cdot \sin \delta_1$$

Nomogram, Fig. 21, allows Δ to be determined for various ratios of h/d and the front adjusting angles κ_1. It will be seen that in the case of facing tools, i.e., where $\kappa_1 = 90$ deg, height adjustment has no effect, the maximum being with cutting-off and grooving tools where $\kappa_1 = 90$ deg.

BORING BARS WITH INCLINED SHANKS

Boring bars with an inclined tool shank are frequently employed, and this is particularly the case with boring bars of small diameter, since here the bearing of the shank in the holder becomes longer; for instance, in the case of an inclination of 45 deg, it is about 1.4 times longer.

For finding the effect of rotation about the shank axis, it is not the angle α_1, of the leading edge which has to be considered, but the angular difference $\delta_1 - \varphi$, Fig. 22, in which φ is the fixed angle through which the shank has been turned from the radial position; for instance, where $\varphi = 30$ deg we have to use $\delta_1 - 30$ deg, but the other considerations remain the same.

Appendix 1

ANALYTICAL SOLUTION

Assuming the cutting edge to lie originally in the x, y-plane, when it is tilted at angles w and v, it is raised in the x, z-plane at

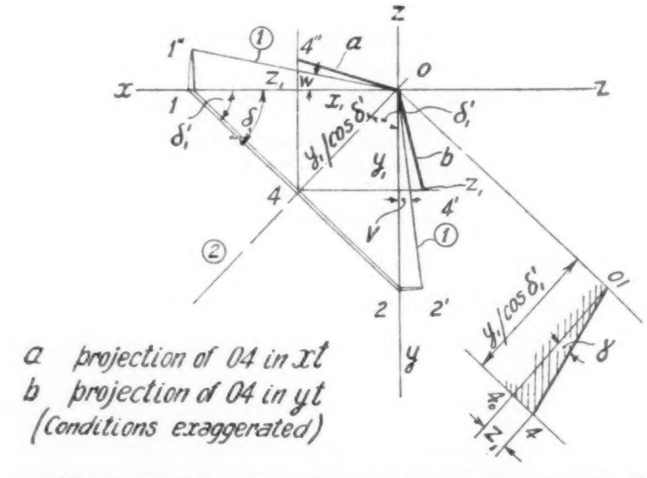


FIG. 23 DIAGRAM FOR ANALYTICAL SOLUTION COMPOSED OF THREE PLANES OPENED OUT IN PLANE OF DRAWING PAPER

an angle w and in the y, z-plane at an angle v, Fig. 23. The intersection of these two planes forms the straight lines

$$\text{I} \quad z = x \cdot \tan w; \quad y = 0$$
$$\text{II} \quad z = y \cdot \tan v; \quad x = 0$$

The equation of the plane of the cutting edge intersecting the origin 0 has an equation of the form

$$Ax + By + Cz = 0$$

Since it has to fulfill the conditions I and II, we have

$$y = 0; \quad A = \tan w; \quad C = -1$$
$$x = 0; \quad B = \tan v; \quad C = -1$$

from which may be derived

$$x \tan w + y \tan v - z = 0 \ldots\ldots\ldots [\text{Plane } 1]$$

This plane has to be intersected by another which is perpendicular to the cutting edge, that is to say, in a plane whose projection on xy includes with the x-axis the angle δ_1'. As this plane also goes through the origin and through the z-axis, its equation has the form

$$A_1 x + B_1 y = 0$$

where

$$\frac{B_1}{A_1} = -\tan \delta_1$$

hence

$$x - \tan \delta_1' y = 0 \ldots\ldots\ldots [\text{Plane } 2]$$

Planes [1] and [2] have to be brought to intersection, as for instance, by eliminating x and from this we obtain the projection of the intersection line in the yz-plane

$$y_1 (\tan \delta_1' \cdot \tan w + \tan v) - z_1 = 0$$

The real length of the intersection line is

$$k = y_1 / \cos \delta_1'$$

and the inclination in the Plane [2] is

$$\tan \gamma_r = z_1/k = \sin \delta_1' \cdot \tan w + \cos \delta_1' \cdot \tan v$$

The original angle of the cutting-edge plane is

$$\tan \delta_1 = \tan \delta_1' \cdot \cos w / \cos v$$

Since $\cos w \approx 1$ and $\cos v \approx 1$, we can also write approximately

$$\tan \gamma_r = \sin \delta_1 \cdot \tan w + \cos \delta_1 \cdot \tan v$$

The slope λ of the plane [1] from 1″ to 2′ can be found to

$$\tan \lambda = \frac{z_1 - z_2}{\sqrt{x^2_1 + y^2_1}}$$

with $z_1 = x_1 \cdot \tan w$, $z_2 = y_2 \cdot \tan w$ and $y/x = \tan \delta_1'$, when replacing $\sin w$ by $\tan w$ and $\sin v$ by $\tan v$ we obtain the relation $\tan \lambda = \cos \delta_1' \tan v - \sin \delta_1' \cdot \tan w$.

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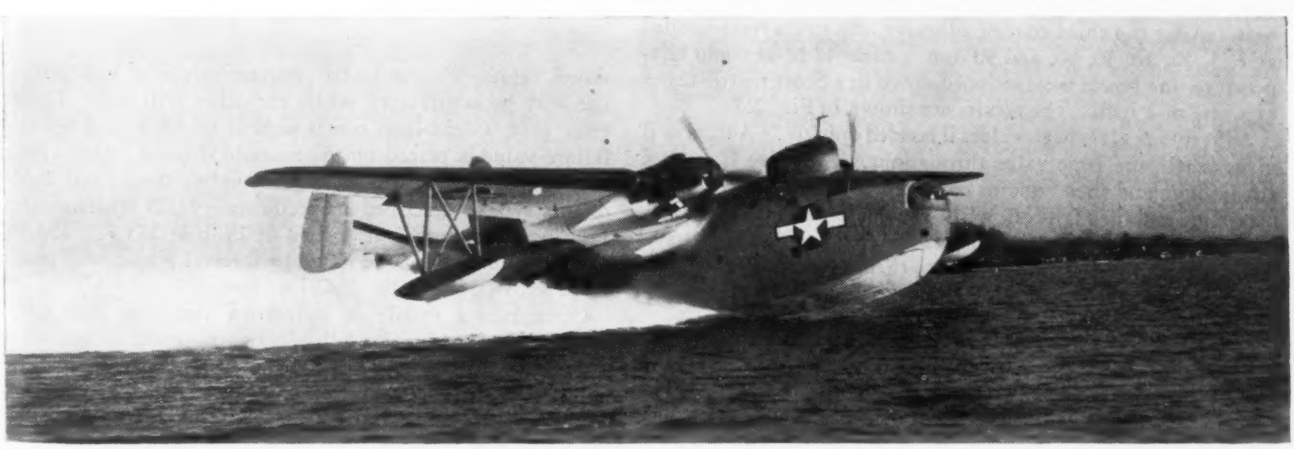


NEW MARTIN BOMBER PBM-5 WHICH HAS ALREADY SEEN COMBAT ACTION IN THE PACIFIC WAR THEATER

USE *and* EVALUATION *of* *Some* SPECIALTY ADHESIVES

By FRED WEHMER

TECHNICAL DIRECTOR, ADHESIVES DIVISION, MINNESOTA MINING & MANUFACTURING CO., DETROIT, MICH.

BECAUSE there are many types of adhesives and many uses to which they may be put, no simple test yet devised seems to answer all requirements of a universal test. The adhesive must adhere to both surfaces of materials, bonded either through specific adhesion, or by mechanical anchorage through entering voids as in fabric or other porous material. The adhesive material must also have cohesion, or the ability to hold together when placed under a strain. Thus cohesion and adhesion are the same force; acting in the case of the former between adjacent parts of the same body, while the latter provides a similar interaction between the closely continuous surfaces of adjacent bodies.

There are two critical ways in which force can be exerted on a bonded surface. The first and perhaps the one most often evaluated is in shear. The second is in direct tension, as when two blocks are pulled apart. Naturally, in actual use, an adhesive may encounter either or any combination of the two. The combination of them is illustrated by the peelback or stripdown as when a flexible material is stripped from a rigid base.

METHODS OF TESTING BOND STRENGTH

Five nonvulcanizing adhesives have been chosen to illustrate methods of testing bond strength. In Fig. 1, values obtained by shear test, tensile test, and stripdown test are compared.

The values obtained in the shear test are higher by far than those obtained by the stripdown method. The tensile values come at an intermediate point. The method chosen for testing any particular adhesive will probably be determined partially by the way in which the adhesive is to be used. Both tests were made by coating No. 10 duck with three coats of adhesive and bonding a 1 × 1-in. area in the case of shear tests, and a 1 × 8-in. strip in the case of stripdown tests. These specimens were pulled in a Scott tensile tester at a rate of 2 inches per minute.

The time at which an adhesive is bonded has an influence on its strength. The adhesives referred to in Fig 1 were coated onto 1-in. strips of No. 10 duck in three coats at 15-min intervals. After the third coat of adhesive, the strips were bonded at 2, 5, 10, 20, 30, 60, and 90 min. After 48 hr at room temperature, the bonds were stripped down in a Scott tensile tester at a rate of 2 ipm. The results are shown in Fig. 2.

Adhesive A gives high values if bonded quickly. Adhesive B gives nearly the same value throughout. Adhesive E reaches a maximum and then remains constant. Adhesive C reaches a maximum and then falls off, while D comes steadily downward. Examination of this graph shows that some adhesives have much better properties of welding to themselves than do others. It also shows that it is necessary to use an adhesive correctly to derive its optimum value.

Strength tests by no means tell the whole story in the evaluation of adhesives, since the usage to which the adhesive will be put will determine the evaluation used. For instance, where two adhesives, each giving the same shear and stripdown values, are put under constant strain of low intensity, one may be satisfactory while the other will fail. To determine this, a dead-load test is used in which a load below the failure value is placed on the assembled bond. One adhesive may support the weight and the second gradually fail. A test of this type is described in Specification 26571 where an area of 1 sq in. must stand a dead load of 25 lb at 115 F. The shear test is a minimum of 150 lb, and adhesives which will pass the shear test will fail on the dead-load test.

Oftentimes a tensile or stripdown test does not tell the whole story, since some adhesives show good values when a slow steady force is exerted, but they fail under a sudden quick pull.

The conditions of use must also be evaluated since many adhesives may show excellent properties when tested at normal temperatures, but may fail at elevated temperatures or at very low temperatures.

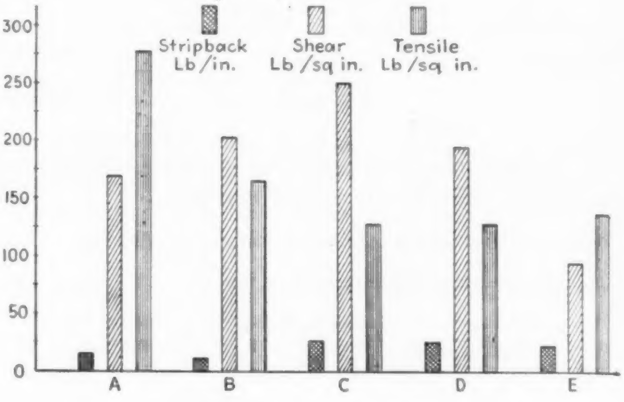


FIG. 1 STRENGTH VALUE OF FIVE CEMENTS

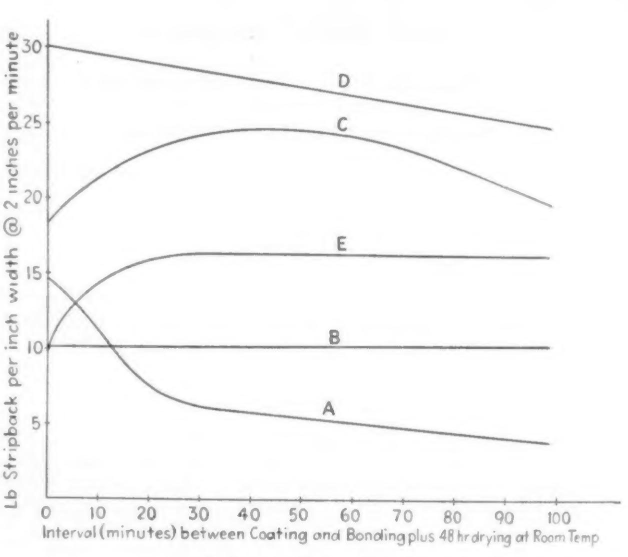


FIG. 2 BONDING RANGES

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., Nov. 27-Dec. 1, 1944, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

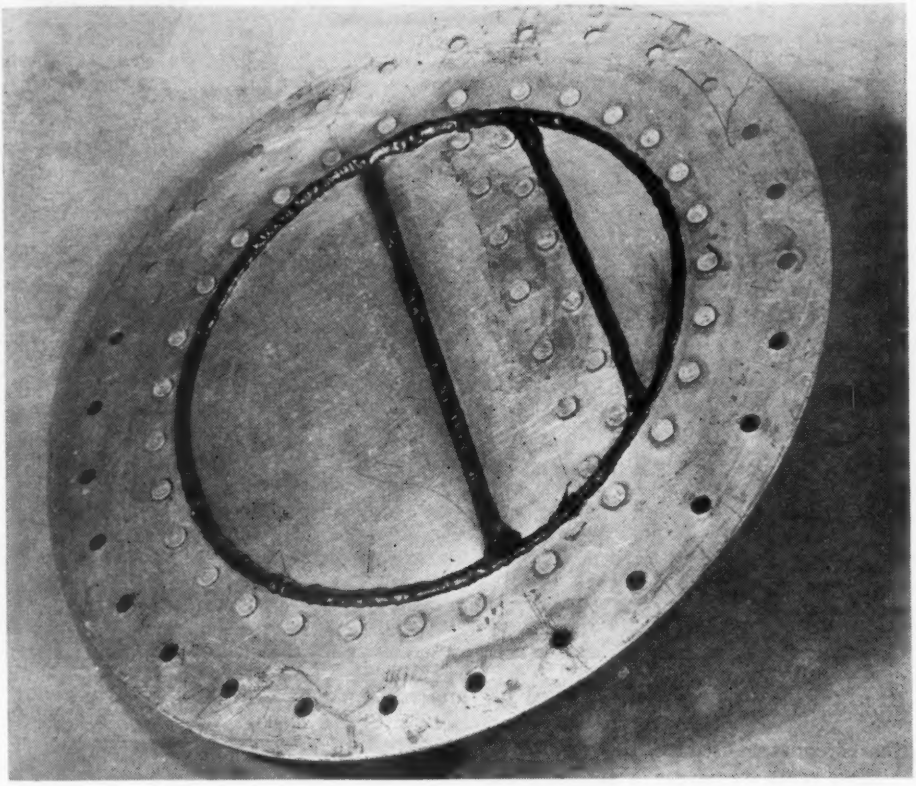


FIG. 3 TEST PANEL SIMULATING TYPES OF JOINTS AND EDGES TO BE SEALED FOR PRESSURIZING PLANE CABINS

(Dark portions indicate sealing compound.)

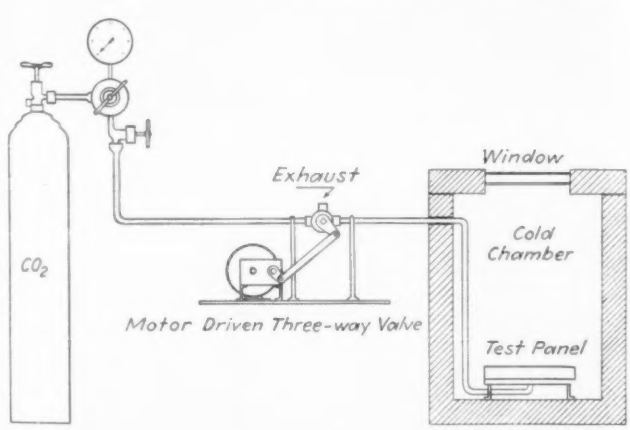


FIG. 4 SCHEMATIC DIAGRAM OF CABIN-SEALER TEST EQUIPMENT

The permanency of the bond is determined by aging the assembly in the Geer oven, the oxygen bomb, or the air bomb. When the conditions are such that the bond must withstand oils, solvents, or water, it is well to make tests against these materials. This is usually done by immersing in the solvent against which the adhesive must be used.

There are also specification tests which are used to insure maintenance of quality. These are usually routine tests, such as solids content, to insure that an adhesive is properly formulated; viscosity, to insure that the material will work properly; stability in the container, usually by aging at elevated temperatures; strength tests, to insure uniformity of results. These tests are usually run on each lot of adhesive made, in order to make sure material of the correct grade is being sent to the customer.

The testing of adhesives is of great interest. This is shown by the fact that a standing committee has been formed by the American Society for Testing Materials to set up standards for the testing of adhesives. This is a step in the right direction since today everyone in the industry is now testing according to his own ideas.

SERVICE-TYPE TESTS FOR ADHESIVES

All the tests mentioned thus far are laboratory evaluations. It seems that, although strength, stability, and aging properties may be measured, there is still only one real way to find out if an adhesive has merit. That is to try it out on the structure in which it is to be used. Many times, of course, this is not possible. At such times the results obtained by laboratory testing can be compared with results from known compounds, and by using good judgment only those materials with real merit will be evaluated on the job.

The conditions under which an adhesive will be used will influence its testing. If it is to be used at low temperatures, this condition should be emphasized in the testing. If the conditions are to be those of high heat, that will have to be taken into consideration.

To illustrate how special apparatus is sometimes used to evaluate an adhesive for a particular job, the apparatus used in the development of a sealer used in pressurizing the cabins of planes will be described. The adhesive is of a type which must bridge a gap and prevent the flow of air through seams in the metal structure. It must withstand conditions when the plane is on the ground and must also be able to withstand the very low temperatures of high altitudes.

To obtain seams similar to those used in a cabin, a test plate was made which simulated the types of joints and faying edges to be sealed. This panel, illustrated in Fig. 3, was small enough to allow easy handling and yet was flexible enough to simulate conditions on an actual plane. This panel was then sealed on the pressure side as shown in Fig. 4, and the compound used was given an opportunity to dry and reach its maximum strength.

The test panel was then fastened into the flex-testing fixture, Fig. 5, and was pressure-tested at room temperature with a pressure of 15 psi. The fixture was installed in a cold box and pulsated at the rate of 35 pulsations per min, as illustrated in schematic drawing Fig. 6. This pressure provided a movement of approximately $^1/_{16}$ in. at the center seam of the panel. The test panel was covered, opposite the pressure side, with a low-boiling naphtha, for low-temperature tests and water for heat tests. The temperature of the panel was checked by a thermometer immersed in the liquid. The whole unit could be observed through the glass door in the unit.

Materials to be tested were pulsated, and the temperature was reduced. The materials were run until failure occurred, as evidenced by bubbles in the liquid which was used. For materials which did not fail at —95 F, the panel was aged for 7 days at 170 F, and then the pulsation test was repeated to —95 F. By this means, it was possible to evaluate the materials at conditions which nearly approached those under which the material was to be used.

It should be pointed out that strength tests were run in con-

junction with this special evaluation. Tests of this nature must be comparative and are really not of much value unless a standard material is available with which to make a comparison. If under the same conditions it is possible to make one material fail while a second does not, the material which does not fail will also be best in actual service unless the conditions of testing were poorly chosen.

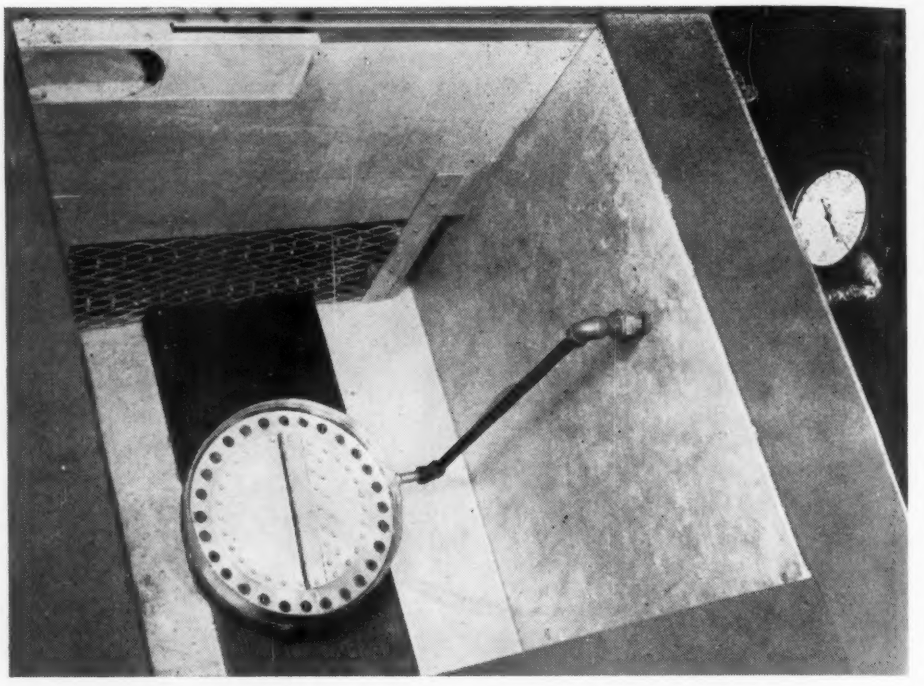


FIG. 5 TEST JIG MOUNTED IN COLD CHEST

SPECIALTY USES FOR ADHESIVES

A few specialty uses of adhesives will be mentioned. One method of using adhesives consists of coating them on films such as on papers to make tapes. The adhesive may then be such that adhesion is obtained by merely pressing the tape in place, or the adhesive may be activated by a solvent or the application of heat. These adhesive tapes find application for many purposes such as sealing cartons, surgical tape which is used with dressings on wounds, the transparent tapes used for mending books and closing packages. These tapes are unique in that the adhesive is ready for use without the necessity of waiting for the solvent to dry, and for many specialty applications they provide an ideal way to make use of adhesives.

A large adhesive field and one which is growing is the field of structural adhesives. These may range from the vulcanizing adhesives used to fasten rubber and synthetic rubbers to metal, to adhesives for plywood, to adhesives such as "Cycle-Weld" for the lamination of metal parts. This field is being exploited very vigorously at the present time, and it is believed that the developments in this field will be many and outstanding.

Another type of material which has unique properties is that made from latex or water-dispersed resins. Included in this group are the water-dispersed reclaims, and the glues and starches. They offer the advantage of a nontoxic solvent together with the fact that there is no fire hazard connected with this type of material. Materials of this type find a large usage in combining paper and cloth. Crude- and synthetic-rubber latex give unique films in that they are flexible over a wide range and possess considerable elongation.

Resin and synthetic-rubber combinations have been used for some unique installations. On aircraft and ships it is necessary to provide a surface on which the personnel can walk without danger of slipping. This has been accomplished by the application of a lightweight deck covering bonded to the deck by means of an adhesive. This adhesive must have good application characteristics plus the ability to withstand water, the low temperatures of high altitudes, and also the high temperatures of tropic climates.

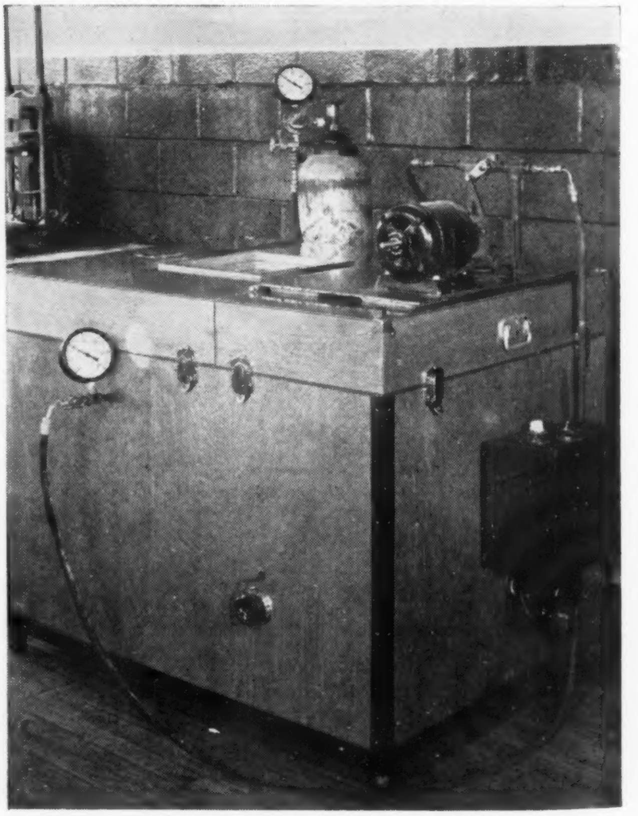


FIG. 6 COMPLETE ASSEMBLY USED FOR TEST

Adhesives are also finding use in the application of coatings for the lining of chemical equipment. Through the use of adhesives in combination with compounds designed for application over these adhesives it is is now possible to line large tanks in the field which has certain advantages over the fabrication of complete structures in a factory.

In conclusion, it seems, in view of the large number of adhesives and the many adhesive uses, that a simple test to evaluate adhesives will not be forthcoming. Best methods of evaluation are those which must closely approximate the actual conditions under which the adhesive will be used.

The adhesives industry will continue to grow; with many of the specialty adhesives we have only scratched the surface as far as uses are concerned.

ACKNOWLEDGMENT

This paper would not have been possible without the cooperation of the R.T. Vanderbilt Corporation, the Chrysler Corporation, and the Firestone Rubber and Latex Products Company. We should like to thank them for their help and suggestions.

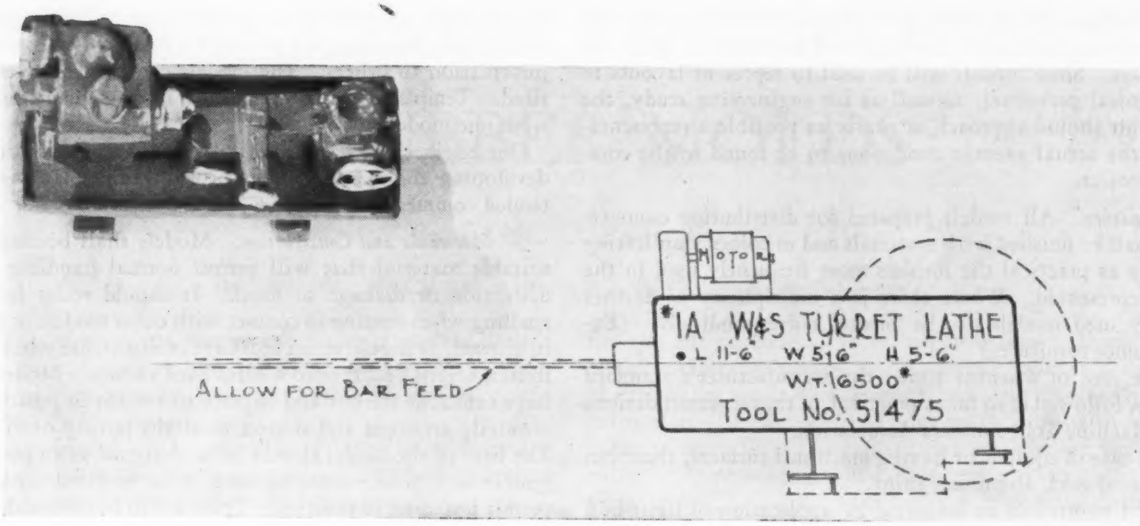


ILLUSTRATION SHOWING THE USE OF THREE-DIMENSIONAL MODEL AND TWO-DIMENSIONAL TEMPLATE

Three-Dimensional
PLANT-LAYOUT MODELS

Suggested Standards

By R. W. MALLICK

SECTION ENGINEER, WESTINGHOUSE ELECTRIC CORPORATION, EAST PITTSBURGH, PA. MEMBER A.S.M.E.

THE following assumptions were made in the preparation of this paper: (1) That the data presented would be used to whatever extent practical in the preparation of standards which would later be sponsored by the Society as a guide to all engineers in the preparation and use of models for plant layout. (2) While as neutral and comprehensive as possible, these suggestions would primarily reflect the user's views from a standpoint of utility of models for engineering purposes. Considerations of applicability for advertising or sales promotion are not included. (3) That other papers reflecting other views, studies, and considerations will be presented to offset the deficiencies of scope which necessarily exist in this initial attempt at standardization.

The suggestions set forth in this paper are the result of studies and practical applications in our own company as well as discussions, experiences, and practices of others who have applied this means of plant-layout approach. Consideration has also been given to standards already established in other fields of engineering with which plant layout is closely associated.

BASIS OF THREE-DIMENSIONAL PLANNING

With this background of thought, we can now review the principal points for which standards should be established and followed to allow for uniformity of practice among engineers, and to encourage the commercial production of models, to accelerate the broader application of three-dimensional planning.

Contributed by the Materials Handling Division, Plant Layout Section, and presented at a meeting of the Metropolitan Section, New York, N. Y., January 31, 1945, of The American Society of Mechanical Engineers.

1 *Scale.* The recommended scale for plant-layout engineering models is $^1/_4$ in. to 1 ft of actual size of the object represented. This will apply to all dimensions.

Discussion. This scale has been standard for years among architects and engineers engaged in industrial-plant design, and the majority of existing records are at this scale. Experience has proved this scale to be sufficiently small to permit the layout of relatively large projects, yet adequately large to permit the study and arrangement without the danger of inaccuracy caused by too small a scale. For exceptionally large projects the panel system of drawing now used by a number of companies provides the benefit of using this standard scale, without the need of resorting to unusually large drawings of inordinate dimensions. The models should be made to the same scale as drawings so that models can be directly superimposed on floor-plan drawings for the purpose of study and presentation.

2 *Detail.* The amount of detail to be designed into the model shall be governed by its utilitarian value. Sufficient detail as to form, shape, contours, special design features, etc., should appear to make the model readily distinguishable as representative of the actual equipment. Unless no other means of assimilation are possible, no moving parts should be designed into the model. All points of control should be clearly indicated. Hazard areas should be clearly indicated. All moving parts should be shown in mid-point or neutral positions. Control or operating points should be in normal or neutral positions. Models should in no way be distorted from actual appearance of the equipment represented.

Discussion. Distortion of models will lead to optical illusions

and probable errors in study of arrangements. Clearances and other features necessary to consider will be discussed under the next point. Since models will be used to represent layouts to nontechnical personnel, as well as for engineering study, the final result should approach as nearly as possible a representation of the actual average conditions to be found in the completed project.

3 *Finishes.* All models prepared for distribution commercially shall be finished with materials and in colors, duplicating as nearly as practical the finishes most frequently used in the object represented. Where there is a multiplicity of finishes normally used models can be finished correspondingly. (Example, office furniture.)

In the case of machine tools, the manufacturer's standard should be followed in so far as practical, or the recommendations of the Machine Tool Builders Association.

In the case of equipment having machined surfaces, these can be indicated with aluminum paint.

Control points can be indicated by application of light-buff paint as recommended for two-tone painting of equipment for better visibility and safety.

Where models are made and/or used exclusively by one company or client, its particular practice should be followed.

Discussion. True representation can be best achieved by an accurate duplication of conditions. Unless a standard of finish is followed as noted, models prepared or secured through several sources will not harmonize.

4 *Allowances and Clearances.* With each three-dimensional model shall be furnished a two-dimensional template showing all clearances required under extreme operating and service conditions of the machine proper. The template shall not show requirements of operator, materials, auxiliaries not fixed to the machine, or other conditions not required in the basic machine or equipment. The template shall be imprinted with all pertinent information required by the planning engineer and shall include or provide for at least the following information: Name or description, model number, type, size, owner's identification number, maximum clearance dimensions (length, width, height) center lines, and weight. Where the template is too small practically to contain all the foregoing information, the name and model number only shall be provided. Where possible, data on overhead or underground requirements should be shown.

Discussion. Three-dimensional layouts have their primary value in engineering study and presentation to nontechnical persons. They do not afford permanent records, nor can certain conditions of engineering significance be presented. Therefore the two-dimensional template used in conjunction with the three-dimensional model provides the greatest benefit of both means of plant-layout approach. When arrangement of a unit is determined, the placing of the template under the model provides the missing features and when fastened in position, it provides a permanent record of the selected arrangement. It can then be reproduced for permanency by photography, or engineering drawing, and provides a means of transmitting the information to others. The models can then be re-used as desired. Templates can be furnished in any quantities for use with one model.

One engineering firm advanced this plan of approach and is developing the details. If meritorious, the plan may be extended commercially.

5 *Materials and Construction.* Models shall be made of any suitable material that will permit normal handling without distortion or damage to finish. It should resist fracture or spalling when coming in contact with other models or materials in general. It should resist breakage or distortion when dropped from a height of 2 ft onto a solid hard surface. Models should have sufficient weight and balance to remain in position when normally arranged and subject to slight jarring or vibrations. The base of the model should be so designed as to permit it to remain in a position once placed or to be fitted with pins to permit fastening in position. These are to be optional with the user.

Where pins are used the template should be pierced with holes to allow the model to become accurately located in relation to the template and the entire assembly held in position on the board by the pins fitted to the model base.

Discussion. Models must be reasonably durable to be of value. Tendency to slight this consideration will have a definite reaction toward their use.

6 *Identification.* Models shall bear the name and/or trademark of the equipment represented. The model number or size description should also be included if possible. Abbreviations or initials should be used where practical. The markings should be made in the most suitable place rather than attempting to place them in the same position as on the actual equipment.

Discussion. Markings, especially size or type description, are essential to prevent errors in preparing layouts. The probability of interest on the part of equipment suppliers in furnishing models of their equipment also justifies correct identification for whatever advertising value it possesses.

The six points which have been covered appear to be the basis on which standards for plant-layout models can be formulated. It is expected that further contributions will be made by equipment manufacturers, consulting engineers, and model builders, as well as those with user corporation interests.

CONCLUSION

In conclusion, it is believed that in sponsoring this action the Society should endeavor to bring to a rapid conclusion the formation of tentative standards and make them publicly available as soon as possible so that the science of three-dimensional plant layout will not suffer the experience of other fields which developed rapidly, uncoordinated and unaided by standards and with detrimental effects to the profession.

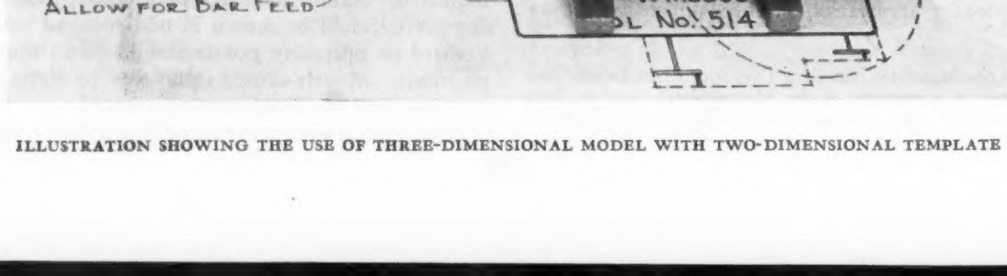


ILLUSTRATION SHOWING THE USE OF THREE-DIMENSIONAL MODEL WITH TWO-DIMENSIONAL TEMPLATE

Making Standard CAST MODELS *in* RUBBER MOLDS

By PAUL LUPKE, JR.

CHIEF ENGINEER, ESSEX RUBBER COMPANY, INC., TRENTON, N. J. MEMBER A.S.M.E.

THE objective of the present process is to produce limited numbers of more or less complex pieces, without investing in high-cost dies, without highly skilled labor, and on short notice.

A positive pattern of the desired model may be made by any economical method and of any material capable of withstanding several hundred pounds hydrostatic pressure at about 300 F, without distortion, breakage, or deterioration. The surface must be nonadhesive to vulcanizing rubber compositions. A two-piece rubber casing is then vulcanized over the pattern, and this casing serves as a mold for casting models of any alloy not requiring over 600 F for high fluidity. Centrifugal force is applied to obtain a dense casting. After the metal cools, the pieces are stripped from the separated mold and finished as desired. Because of the elastic flexibility of this mold, draft is not required and undercuts are possible.

MATERIALS FOR MOLDS

So-called "superaging" vulcanizable compositions of rubber are found to withstand pouring temperatures between 500 and 600 F for several hundred repetitions of casting without undesirable surface deterioration of the cavities, making mold costs very moderate. For flat pieces and pieces without undercuts, particularly those of fair size, a composition of sufficient stiffness to resist cavity distortion by centrifugal force is desirable. Such a composition resembles a solid truck tire in consistency and should approximate 1.30 in specific gravity, have a raw plasticity of 30 to 38 on a Mooney plastometer, a vulcanized Shore durometer hardness of 70 to 75, a tensile strength not under 2500 psi, and an ultimate elongation of 300 per cent or more. For pieces with medium to heavy undercuts, a composition of 1.15 to 1.20 specific gravity with a raw plasticity of 20 to 24, a vulcanized hardness of 60 to 65, a tensile strength of about 3000 psi, and an ultimate elongation of 500 per cent or more is desirable.

In costume-jewelry manufacturing a mold 1 in. thick and 9 in. diam is usual. This is vulcanized from two raw disks $^{17}/_{32}$ in. thick and a small fraction under 9 in. diam. These blanks must be cut from carefully calendered stock, smooth and free of trapped air. Trapped air results in blisters in the cured mold. Blisters open to the cavities cause rough protrusions on the castings; sealed blisters may permit cavity walls to yield under centrifugal force and give distorted surfaces.

PREPARATION OF MOLDS

A blank disk with a $1^5/_8$-in. hole punched in the center is used for the cope of the mold. Placed with its inner face upward, a circle of patterns is laid out upon it with their outer edges about $^3/_4$ in. from the outer edge of the disk, their positions marked, and the corresponding positions marked on the matching face of another disk, which will be used as the newel. If any of the patterns has deep sections, it is well to clip or cut cavities into the disk of a little less volume than the portions of the patterns to be forced into them. If any pattern has a considerable hollow in the upper or lower side, a clipping of the rubber stock may be stuck onto the disk at the proper point after cleaning both surfaces by rubbing with benzol or naphtha and allowing them to dry well before pressing together. At points in the newel well clear of any of the patterns three or four holes are punched into which $^3/_8 \times ^1/_2$-in. cap screws may be forced, with their heads protruding. These serve as dowels.

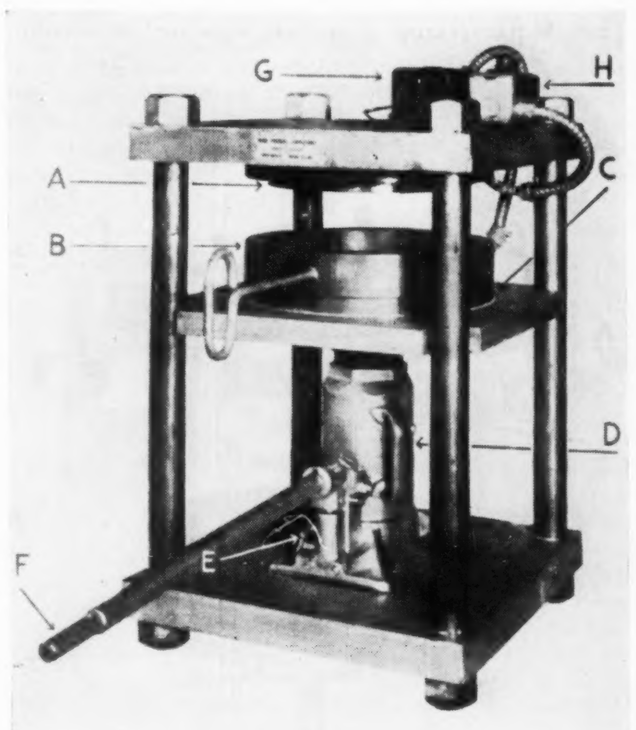


FIG. 1 ELEMENTARY TYPE OF ELECTRICALLY HEATED VULCANIZING PRESS, HAVING ALL ESSENTIAL FEATURES

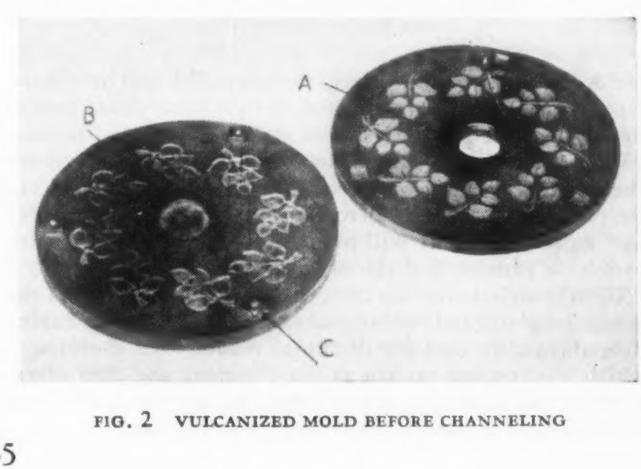


FIG. 2 VULCANIZED MOLD BEFORE CHANNELING

Contributed by the Materials Handling Division, Plant Layout Section, and presented at a meeting of the Metropolitan Section, New York, N. Y., Jan. 31, 1945, of The American Society of Mechanical Engineers.

The disks, thus prepared, are preheated to 120 to 140 F to render them more plastic. A time of 15 to 30 min should be sufficient for the warmth to penetrate to the center of the thickness without overheating the surfaces. The disks are then vulcanized over the patterns in a plunger-type mold preheated to 300 F between steam or electrically heated press plates, maintained at this temperature throughout the 45-min cure. The matching faces of the disks are heavily dusted with fine talc or wet evenly with glycerine to prevent adhesion of one to the other, and to the pattern. The cope disk is placed top-side down in the mold over the sprue plug on the lower plate of this

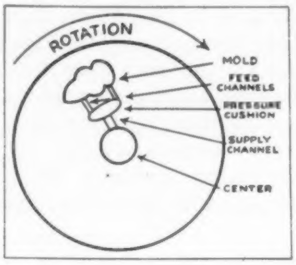


FIG. 3 ILLUSTRATING A GENERAL PLAN FOR CHANNELING

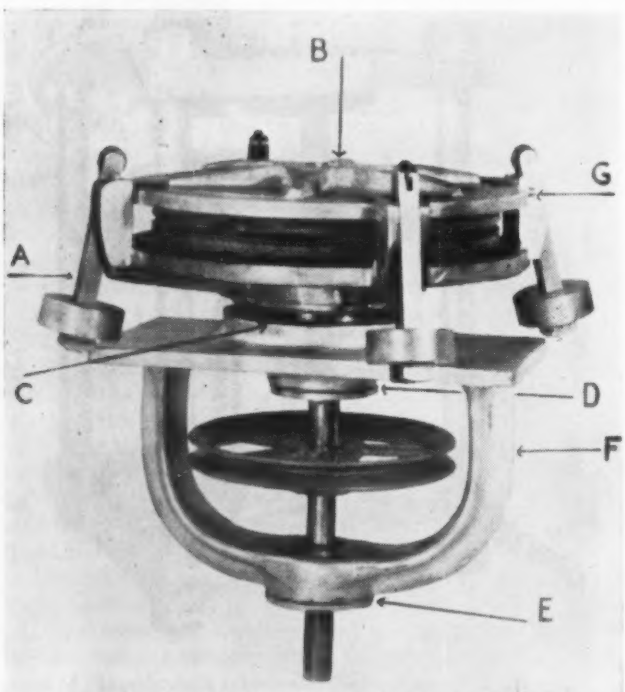


FIG. 4 AUTOMATICALLY CLAMPING CENTRIFUGAL MACHINE
(A 1/4-hp 1750-rpm vertical motor with V-belt drive operates the machine at 2500 rpm.)

mold, the patterns put in place, the newel disk laid over them, face down and properly oriented, the top plate placed over it in the ring, the assembly slipped into the press, and pressure applied. Application of pressure should be gradual to permit the warming and softening stock to flow around the contours of the patterns and brought up to 250 to 500 psi on the rubber in 3 to 5 min. Experience will indicate desirable variations with particular patterns and rubber-stock consistencies.

Upon completion of the cure, the mold is removed from the press, the plates and rubber pushed from the ring, the rubber then allowed to cool for 10 min to reduce "hot shortness," which might cause tearing at sharp corners and thin edges. A blunt tool is used to pry the mold halves apart, these are cooled further in water and the patterns withdrawn.

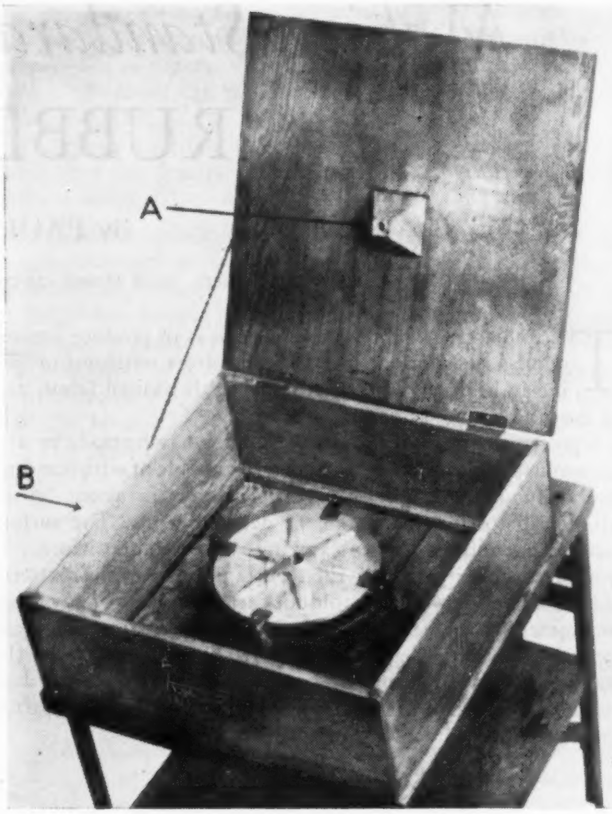


FIG. 5 PROTECTION BOX FOR POURING

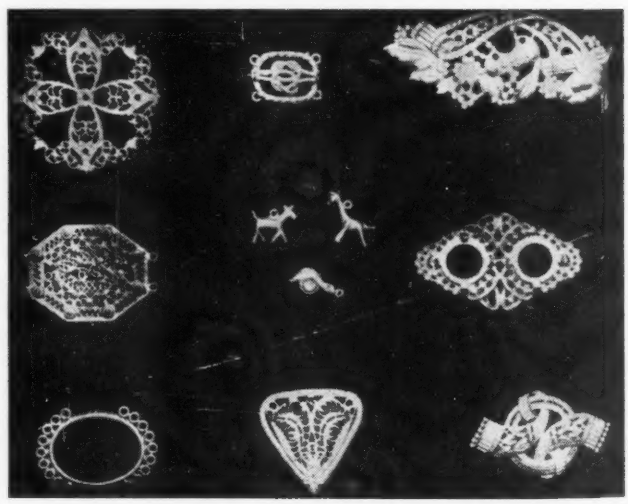


FIG. 6 SAMPLES OF CASTINGS SHOWING INTRICACY AND DETAIL WHICH ARE POSSIBLE

The cope, or the newel, of the mold is now channeled with a scalpel or razor blade. Channels are run radially or with a small backward rake, pressure cushions being used if found advisable, and thin gates cut from the channels to the cavities. Foundry experience applied in miniature is most helpful toward getting consistently good results. Casting is still an art rather than a science in some respects, and patience may be necessary toward acquiring skill.

CASTING PROCEDURE

The halves of the mold are forced together, clamped, carefully centered on the table of a centrifugal-casting machine, spun at 2500 rpm, giving in the neighborhood of 700 times *g*

(*Continued on page 397*)

Use of Modern COATED ABRASIVES *in* WOODWORKING INDUSTRIES

By THOMAS TROWBRIDGE

PRODUCTS ENGINEER, BEHR-MANNING CORPORATION, TROY, N. Y.

THE purpose of this paper is to point out some of the more important developments and improvements made during recent years in the manufacture of coated abrasives, which have greatly increased their efficiency as cutting tools, and also to make a few recommendations for the uses and applications of such products, particularly in the furniture industry.

The woodworking industry has always been one of the largest consumers of coated abrasives. No other raw material requires the use of so much sandpaper during its processing or fabrication as does wood, and this is particularly true when fine finishes are to be applied. Furthermore, up to the present time no more effective medium has been found for this purpose.

It is obvious that this country faces the greatest backlog of new home construction in its entire history. There have been practically no new homes, aside from war housing projects, built since 1938. Nor have there been any remodeling or major repairs undertaken during the last few years. To these conditions has been added a demand for new homes and furnishings from the thousands of young people who have been married since the war began and who will want homes of their own as soon as they are available.

Consequently, unparalleled activity may be anticipated in the entire industry as soon as present restrictions are raised and materials become available. This expansion should last for an indefinite period, as years will be required to satisfy the accumulated need for homes, furniture, and the innumerable other products using wood as a basic raw material.

A great deal is heard these days about new materials and designs which will be incorporated in the homes of the future. No doubt there will be far greater use made of such materials as glass tile, plastics, compressed wall board, aluminum, magnesium, stainless steel and countless others, but it is equally probable that wood will remain the basic staple for home construction and furniture.

This naturally raises the question as to the part coated abrasives will play in such a program of expansion. As the greatest quantity of coated-abrasive products used by the woodworking industries is consumed in the manufacture of furniture and allied products, this paper will be confined chiefly to the use of coated abrasives for these purposes.

DEVELOPMENTS IN COATED ABRASIVES

Some of the developments in the manufacture of coated abrasives which have contributed much to their greater efficiency might be summarized as follows:

1 The Openkote principle of coating.

2 Improvements in construction of paper stock used for roll backings.

3 Development of various degrees of cloth flexibility.

4 Heat-treatment of garnet grain.

5 Improvements in aluminum-oxide minerals.

6 The invention of the "electrostatic" method of coating patented by the author's company.

A better understanding of these various advancements will permit the reader to understand what has been accomplished and how.

The "Openkote" Principle. This coating principle refers to the distribution of abrasive particles over the backing under such control that space is provided between the abrasive grain for the purpose of chip clearance. A coated-abrasive product having more space for waste to accumulate is obviously desirable when sanding soft substances, such as fillers, varnish, paint, etc., particularly by hand or with reciprocating sanders. "Closekote," or a more tightly coated abrasive surface is generally preferred for heavy drum-sanding operations and for most flat belt-sanding where the paper is subjected to more pressure and is required to remove more material. The difference in the two coatings is shown in Fig. 1.

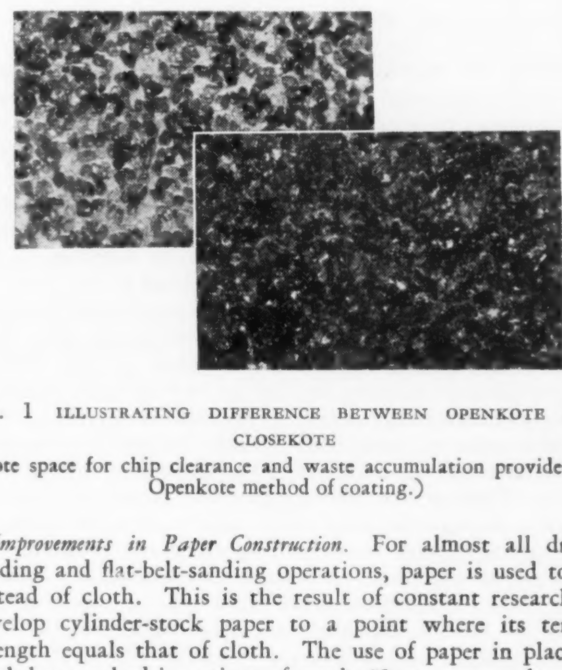


FIG. 1 ILLUSTRATING DIFFERENCE BETWEEN OPENKOTE AND CLOSEKOTE

(Note space for chip clearance and waste accumulation provided by Openkote method of coating.)

Improvements in Paper Construction. For almost all drum-sanding and flat-belt-sanding operations, paper is used today instead of cloth. This is the result of constant research to develop cylinder-stock paper to a point where its tensile strength equals that of cloth. The use of paper in place of cloth has resulted in savings of nearly 50 per cent to the user. Fig. 2 shows method of testing paper for tensile strength.

Development of Various Degrees of Cloth Flexibility. Much time and research have been spent in the development of cloth backings to provide varying degrees of flexibility for belt-sanding furniture moldings. This has made it possible to eliminate entirely all hand-sanding as there is hardly a molding which cannot be sanded now by mechanical means.

Heat-Treatment of Garnet Grain. This is a process whereby the toughness or temper of the mineral is increased. The advantage of this to the user is longer abrasive wear as the mineral will not break down as quickly.

Improvements in Aluminum-Oxide Mineral. Improvements have been constantly made during the last few years. This

Contributed by the Wood Industries Division and presented at the Annual Meeting, New York, N. Y., Nov. 27–Dec. 1, 1944, of The American Society of Mechanical Engineers.

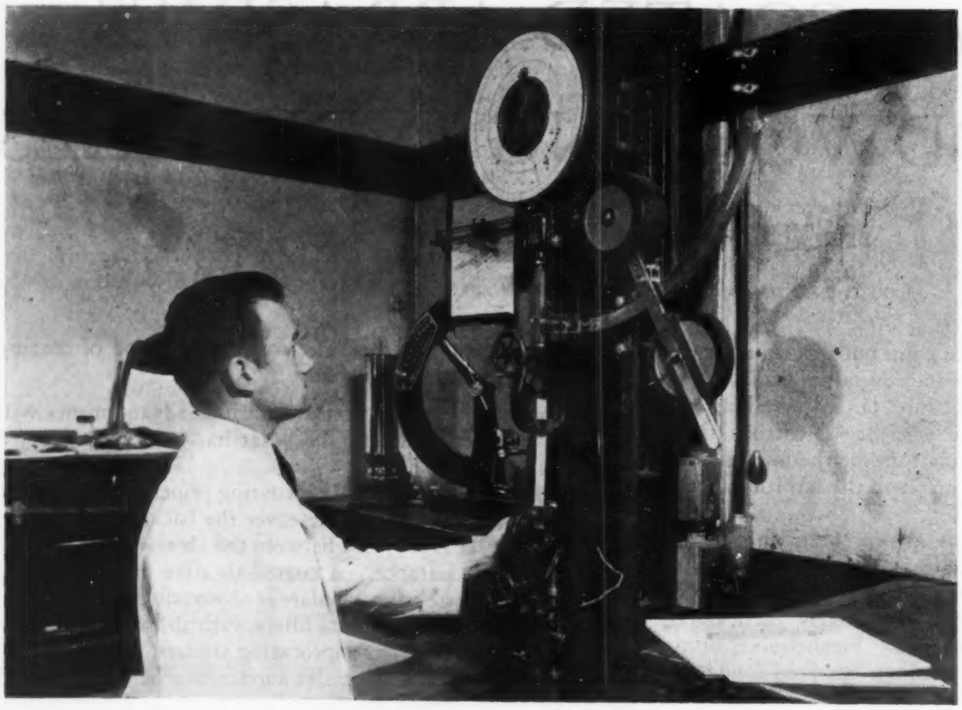


FIG. 2 TESTING PAPER FOR TENSILE STRENGTH

mineral has replaced garnet for many belt-sanding operations because it is capable of being used at higher speeds and will sand more surface per unit. It is to be recommended as superior for sanding many hardwoods which have a tendency to dull other abrasives.

Electrostatic Method of Coating. This method has unquestionably contributed most to the quality of coated abrasives by increasing their cutting action and providing finer and more uniform finishes. By this process, it is possible to control the position each abrasive particle assumes when applied to the backing. Furthermore, the orientation or distribution of particles is also brought under control, resulting in an abrasive surface in which the grain is equally distributed. Elements of the process are shown in Figs. 3 and 4.

To obtain the maximum benefits of improvements constantly being made in coated abrasives, users should periodically study their sanding requirements to make certain that the proper abrasive is being applied to each specific operation. Also, such equipment should be inspected to see that it is in the best operating condition at all times, otherwise the coated abrasives employed cannot be expected to give their greatest value. Where it is possible and practical, consideration should be given to increasing the rate of belt travel on belt sanders to take full advantage of the cutting speed and long life built into modern abrasives. A constant check should be made to insure that the selection of grit sizes and backings is correct. These are but a few of the many factors contributing to the performance of coated abrasive products which should be under constant observation.

SELECTION OF ABRASIVE PAPER

As the problem of reconversion will soon confront the entire nation, it is of general interest to cover a few fundamentals as applied to multiple-drum-sanding and flat-belt-sanding which will contribute toward the improved use and application of coated abrasives. First, there is the problem of determining whether to use garnet or electrocoated aluminum-oxide minerals. In the case of drum-sanding, the element of speed is eliminated as most machines operate at predetermined speeds established by the machine manufacturers, and it is not practical to attempt to change them, particularly as most of them are now direct motor-driven. Furthermore, most drum sanders operate at cutting speeds of approximately 4000 sfm (surface feet per minute) or higher.

Therefore, t heselection of abrasive paper is really dependent on the type of wood being run through. Aluminum oxide is, in most cases, superior to garnet for such woods as walnut, mahogany, birch, gum wood, whereas pine and other resinous woods are sanded equally well with garnet. Hence, due to the fixed speeds of most drum sanders, the selection is really dependent on the wood being sanded. In belt-sanding, however, it is possible to increase the operating speeds, for example, of such sanders as hand-block, hand-lever-stroke and automatic-stroke equipment, depending on the condition of the equipment mechanically. A hand-block belt sander is shown in Fig. 5.

Where belt speeds of from 3500 to 6000 sfm can be estab-

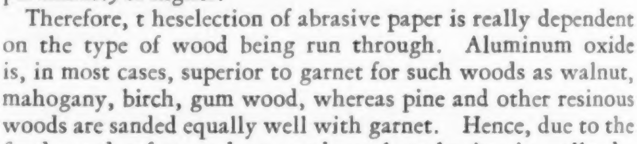


FIG. 3 ABRASIVE PARTICLES PLACED ON END BY ELECTROSTATIC COATING

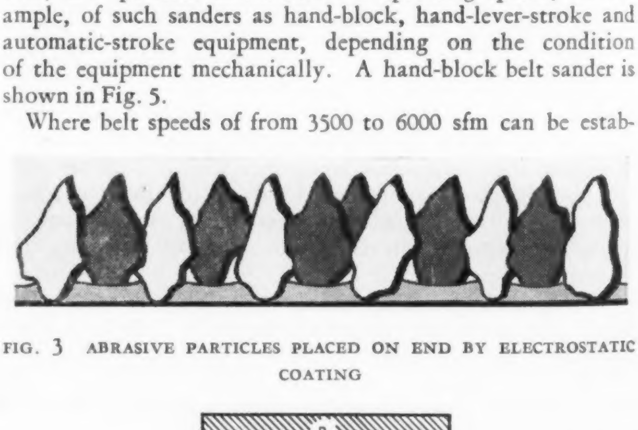


FIG. 4 DIAGRAM SHOWING PRINCIPLE OF ELECTROSTATIC COATING

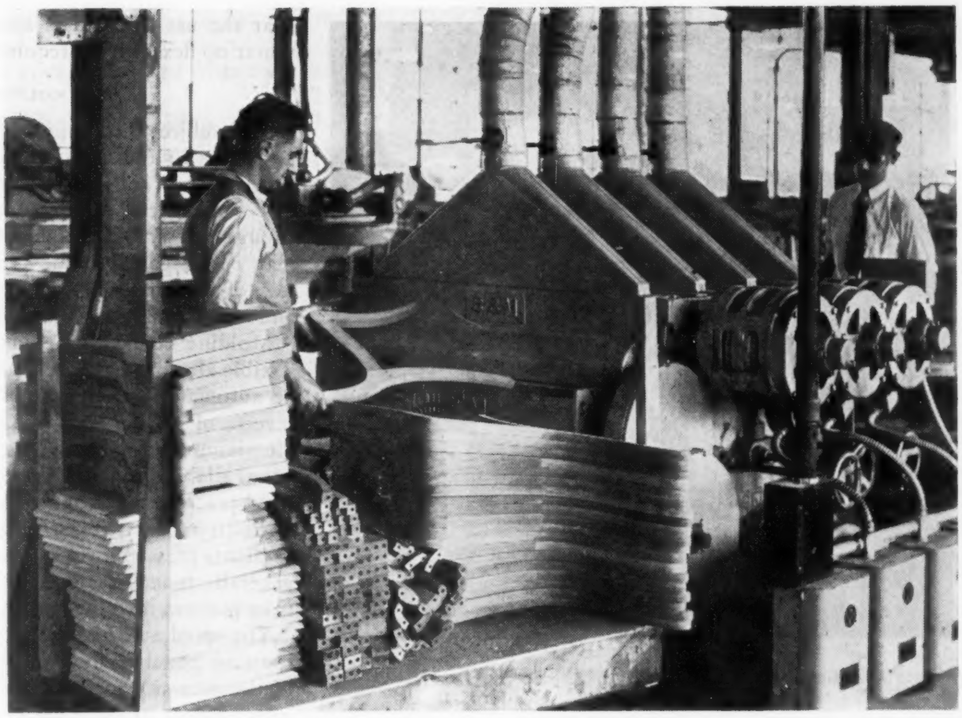


FIG. 6 SANDING CHAIR FRAMES ON A THREE-DRUM SANDER

lished, electrocoated aluminum oxide will give longer belt life than garnet on nearly all types of wood. To obtain the maximum production per belt on hardwoods, the electric-furnace mineral should be used and every effort made to establish belt travel at 6000 sfm, or slightly more. Some excellent belt-sanding machines are operating effectively at speeds as high as 10,000 sfm.

TYPE OF SANDER TO USE

Having given consideration to the type of mineral best suited for given requirements, the next item to be discussed is the equipment. In most woodworking plants the first sanding after machining is done on a drum sander, Fig. 6. To obtain the maximum cutting efficiency and finest finish possible from the coated abrasives used, care must be given to several important factors. The first of these to be considered is the operating condition of the equipment. It is amazing the number of machines operating with worn bearings, poorly applied and torn felt coverings and worn suction pads. Worn bearings will produce poor finishes through exerting uneven pressure and causing the drums to pound excessively; torn or poorly applied felts will bring about the same results through uneven distribution of pressure and will often cause so-called snake-marks; worn suction pads will interrupt the steady flow of work through the machine and generally result in poor machine performance.

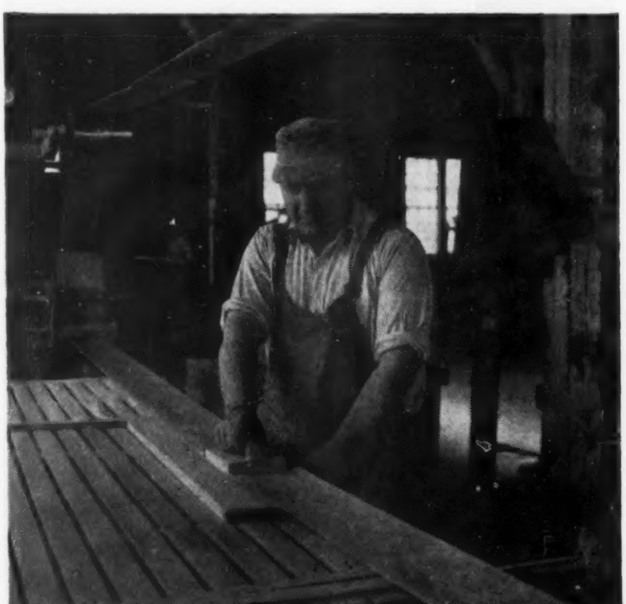


FIG. 5 HAND-BLOCK BELT SANDER

The maximum investment value of coated abrasives cannot be obtained if proper attention is not given to grit selection. This is of prime importance because the sander is expected in most instances to remove all machine marks and prepare the surface for subsequent belting or finishing operations. If modern planers and shapers have been installed, the surface generally is well prepared prior to drum-sanding. Consequently, a finer range of grits can be used. Savings may be obtained at this point through using finer grits with resultant better finishes, thus eliminating some, or all, subsequent belting operations.

Setting the drums for the proper amount of stock removal is another item of importance, and also it is desirable not to change drum covers during a day's run. A good practice in selecting grit sizes is to skip a grade between each drum. For triple-drum sanding in the furniture industry the grades required, from coarse to fine, are generally Nos. 2, $1^{1}/_{2}$, 1, $^{1}/_{2}$, 0, 2/0, and 3/0. Proper selection, of course, depends upon individual conditions but usually Nos. $1^{1}/_{2}$, $^{1}/_{2}$, and 2/0 are used to good advantage, skipping in this case, Nos. 1 and 0. In other words, sanding marks of a given grit size can readily be removed by a grit two numbers finer and maximum production and finish maintained.

FLAT-BELT SANDING

The greatest amount of flat-belt sanding is performed on three types of sanders which are all basically the same, differing only in the operation of the sanding block. These are the hand-block, Fig. 5, the hand-lever-stroke, Fig. 7, and the automatic-lever-stroke, Fig. 8, sanders.

Most modern machines are well designed and equipped with ball bearings or roller bearings, which permit operating speeds

FIG. 7 ILLUSTRATING THE HAND-LEVER-STROKE SANDER IN OPERATION

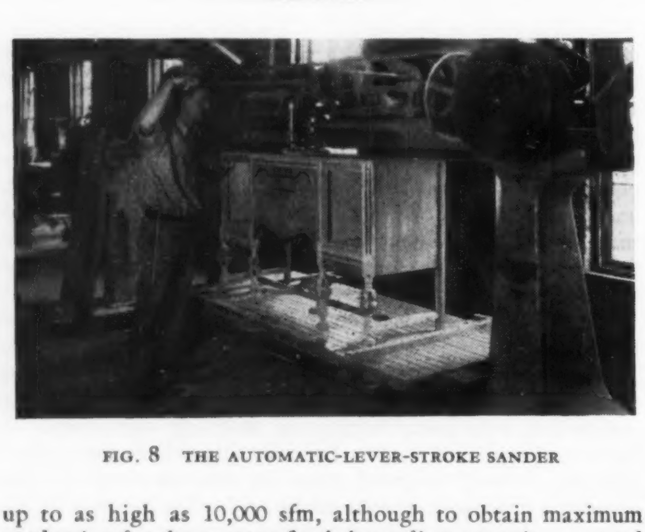


FIG. 8 THE AUTOMATIC-LEVER-STROKE SANDER

up to as high as 10,000 sfm, although to obtain maximum production for the average flat-belt-sanding operation, a speed of around 6000 sfm is adequate. As previously stated, the selection of mineral, i.e., aluminum oxide or garnet, for belt-sanding is dependent largely on the rate of belt travel. When considering any increase in belt speed it is important that attention be given to several important factors, as follows:

1 The kind of equipment in use.
2 Its mechanical condition.
3 Its location in the buildings and its anchorage.
4 The availability of sufficient power.
5 The type of finish required.

If any of these conditions is overlooked when attempting faster belt speeds, there is a good likelihood of causing excessive vibration, resulting in belt breakage, excessive belt wear, and poor sanding results. Where practicable, speeds up to 6000 sfm are desirable because such speeds make possible faster output, greater belt life, and improved finishes with electro-coated aluminum oxide in finer grades than would be possible with either this product or garnet at lower speeds.

If a belt sander is in good operating condition, there is seldom need to use other than paper belts at any speeds at which the machines will operate with safety and economy. The paper in use today so closely approximates cloth in tensile strength, that the use of cloth is an unnecessary expense, particularly where no flexibility is required in the belt.

MOLDING SANDING

This subject is one of great interest to those who are required to produce moldings on a production basis, especially where superiority of finish and minimum cost are important factors. The present era of high-speed machine sanding permits no thought of antiquated hand-sanding methods so that phase may be relegated to the past. There is no molding, regardless of its intricacies, that cannot be sanded more cheaply and more quickly by some mechanical means.

Molding sanding is accomplished by the use of an extremely flexible abrasive cloth belt run through molds applied by hand, or automatically. The molds, of course, are shaped to the reverse of the molding which is to be sanded. Garnet and aluminum-oxide abrasive cloths (Openkoting) for this work are available in many degrees of flexibility but it is generally good practice to use as stiff a cloth as possible because extreme flexibility tends to lessen the life of the molding cloth. It is in plants pressed for production that the most flexible cloth is generally found because little or no time is required to break it in or preform it to the shape of the mold.

The speed at which belts should travel is necessarily slower than for panel sanding (between 2000 and 3500 sfpm) because of the necessity for guiding the belt through the mold. The grits in most common use range from No. 0 to No. 4/0, depending on the type of finish that is desired to make the molding correspond with that of the flat surfaces with which they will be used. The following describes the various types of cloth available:

(*a*) *Finishing Cloth or Molding Cloth.* Finishing cloth, described as such by the coated-abrasive industry, is coated on a backing of extreme flexibility. This cloth can be used without preforming or without much breaking-in, but it does not have the life of some of the stiffer cloths available. Four varieties of flexibility are made and are available in either garnet or aluminum oxide.

(*b*) *Jeans Cloth.* This has slightly more body than finishing cloth and is made also in garnet or aluminum oxide. It is likewise available in four degrees of flexibility, i.e., unflexed, single-flexed, double-flexed, and triple-flexed. This type of

FIG. 9 SANDING THE INSIDE OF A MIRROR FRAME WITH A SHAPED FELT WHEEL COVERED WITH ABRASIVE CLOTH

cloth, however, particularly the unflexed or single-flexed variety, must be preformed or scored to conform to the mold. The greatest production per belt is always obtained from the stiffest type of cloth.

(c) *Jeans Cloth Unflexed*. This is used by some of the most experienced molding sanders, but here again, knowledge of how to break in the belt is of utmost importance.

The use of these various flexible cloths depends to a great extent on the preference of the operator and the type of molding being sanded. The sanding of moldings by use of a shaped felt wheel on the head of a spindle, Fig. 9, covered with flexible abrasive cloth pads is another way of sanding reverse molds and is used very extensively on stretchers and parts of this nature. The cloth recommendations are the same as for belt-sanding.

MECHANICAL FINISHING

Hand sanding, which in past years has been quite extensively employed for spot sanding or touching up in the cabinet room before delivery to the finishing department, is rapidly being replaced by reciprocating or orbital sanding machines, either electrically or air-operated.

Numerous good machines are now available for this work, most of them much lighter and more efficient than those offered even 2 or 3 years ago. Present-day machines are equipped not only for flat sanding, but with shaped shoes or pads enabling the operator to sand curved and irregular shaped objects, many of which do not readily adapt themselves to the older heavy and more cumbersome sanders.

All of these machines are designed to use sheets which can be cut from a standard 9 × 11-in. sheet of cabinet or finishing paper. Such ready-cut sheets can be obtained through regular sources of supply.

The rapid acceptance in recent years of lacquers or synthetic finishes by many woodworking manufacturers has brought about radical changes in the finishing room, among them the use of waterproof sandpaper with oil lubricants and in some cases, with soap and water. Pumice and oil or pumice and water have been used for generations for rubbing down varnished surfaces to bring out the desired luster or finish. This operation has been performed either by hand or through the use of one of several well-known makes of reciprocating rubbing machines. However, as the lacquers are in most cases harder than varnish, waterproof abrasive papers will cut down the surface and remove orange peel and dust nibs much more rapidly. As a matter of fact, savings in labor up to 30 per cent are not unusual.

The popular grit sizes are Nos. 280-A, 320-A, and 360-A. These grits will cut down the surface quickly and leave a finish which can be quickly compounded to the proper degree of depth and luster.

CONCLUSION

Before concluding, it is desirable to touch briefly on proper storage conditions for coated abrasives. All sandpapers, except the waterproof variety, are bonded with glue. Glue is subject to deterioration, and storage in low humidities which allow the product to get too dry will do a great deal of harm.

Ideal storage conditions require that both temperature and humidity be controlled to avoid "cycling." Temperatures between 65 and 70 F are excellent, and relative humidity should be held to between 40 and 50 per cent. Cycling means rapid fluctuation in temperature and relative humidity. Well-suited storage facilities are shown in Fig. 10.

Coated abrasives are used all over the country and are subject to every variable in weather, but each individual plant may help materially in maintaining the high efficiency of the product by making certain that the storage conditions are correct. Never store coated abrasives near steam pipes; maintain a steady room temperature that is neither too moist nor too dry. Instruct factory personnel not to open shipping bales or bundles until the material is actually needed. (The original packing will help a great deal in keeping stock in good condition.)

Modern coated abrasives are actually high-speed cutting tools into which a great deal of service has been built. To obtain the most from them, make sure that the proper product is used for the job, then be equally sure that the sanding equipment is kept in the best possible operating condition.

FIG. 10 GOOD STORAGE OF COATED ABRASIVES

Design Aspects of
SUPERCHARGED DIESEL ENGINES

By R. L. BOYER

CHIEF ENGINEER, COOPER-BESSEMER CORPORATION, MT. VERNON, OHIO

IT has become a popular belief that all one has to do in order to increase the output of a given engine by perhaps 50 per cent is to add a supercharger.[1] While supercharging is an ideal way of increasing the output of an engine and does produce considerably more horsepower for a given weight and given space requirement, it is unfortunately not as simple a matter as just indicated; and there are certain design considerations which must be taken into account. The purpose of this paper therefore is not to discuss details of supercharging but to point out some of the experience gained from the engine-design standpoint. The information contained in this paper has been acquired through experience with engines from 8-in. bore to 15½-in. bore and with speeds from 277 to 1000 rpm. No attempt has been made to cover the experience of others so as to extend down into the automotive range.

NUMBER OF VALVES

The earliest application of supercharging was without change of valve design and was therefore to engines having two valves, or one inlet, and one exhaust. Many successful supercharging applications have been made on two-valve engines. However, due to the absolute necessity of thorough scavenging, it was soon discovered that the four-valve engine, having two inlet and two exhaust valves, was much more thoroughly scavenged and was, therefore, much more adaptable to effective supercharging. For that reason, all later designs have been based on the four-valve type, and all supercharged engines now manufactured by the author's company are of the four-valve design.

While unquestionably the four-valve design is somewhat more costly, it is believed to be well worth the additional cost, considering the more effective supercharging and, therefore, the higher ratings obtainable. Another reason for the four-valve construction is that, since the piston head must contain pockets to clear the valves, a four-valve engine design produces a piston head which is more symmetrical and which is more likely to produce clean combustion. This will be discussed later in more detail.

VALVE TIMING

As noted, scavenging is an extremely important phase of effective supercharging. It is believed that the thorough scavenging resulting from a supercharging system can be responsible for as much increase in output as the supercharging itself. In order to get this effective scavenging, it becomes necessary to have a materially increased overlap of timing of the inlet and exhaust valves. In other words, the exhaust valve is held open longer and the inlet valve is opened earlier in order to provide sufficient overlap to insure a considerable amount of air going directly from the inlet through the exhaust valve, thereby providing a thorough removal of residual gas. Comparative timing diagrams, showing the resulting overlap in the case of supercharged engines, are illustrated in Fig. 1. Considerably less overlap is usually employed where mechanical blowers are used. As indicated, however, the purpose of this paper is to present purely the experiences with turbocharging.

In order to get the altered timing diagram it is, of course, first of all necessary to provide entirely different cams. This, therefore, becomes the first "must" when considering design alterations.

PISTONS

Reference has already been made to the fact that pockets must be provided in the piston heads to clear the valves. Diesel combustion chambers are so shallow that, with direct-injection engines, pistons must usually be notched at the top to clear the valves, even in the atmospheric engine. With the supercharged engine, since the valves are held open much longer and are open an appreciable amount when the piston is on top dead center, these pockets become quite deep. This usually means not only machining the pocket but also a change of the core contour of the piston in order to permit this machining. Therefore, to supercharge an engine effectively a different piston is usually required.

Since the cylinder pressure is maintained over a longer period of time with supercharging, there is naturally some more heat dissipated from the combustion chamber than in the atmospheric engine. The amount of heat dissipation will be discussed later in this paper. This higher rate of heat dissipation must be provided for, which in turn, means giving adequate attention to the cooling of the upper end of the liner and of the piston. It is absolutely essential that the cooling water be brought up near, or even above the position of the top of the piston-ring travel. For moderate or high speeds, especially with the larger engines, it is necessary that the piston itself be provided with some form of adequate cooling. Oil of course is the most accepted means of cooling. While there are various designs possible, all must be based on the requirement that heat be removed from the ring section particularly, whether from the remaining portions of the crown or not. One effective design for accomplishing this is by means of a heat dam between the crown itself and the ring section. To illustrate what is believed to be a good example of efficient piston cooling, Fig. 2 is presented.

CYLINDER PRESSURES

While cylinder peak pressures do not increase anything like as much as popularly supposed, there is no evading the issue that cylinder pressures are increased in the supercharging process. Engines must have sufficient compression pressure to start cold, and in the starting period they have little if any effect from the supercharging. It is obvious therefore that when we now add the supercharging pressure to the inlet air we must expect an increase in the peak pressure.

A study has been made of a large number of atmospheric versus supercharged engines of otherwise identical types, and it has been found that the cylinder pressure usually increases 10 to 15 per cent. This increase in pressure naturally reflects

[1] While the title of this paper refers to supercharged Diesel engines, actually the paper will be confined to the exhaust-turbine-driven blower type of supercharging, more commonly referred to as turbocharging. The author has had but slight experience with mechanical blowers, and this paper will have to do strictly with engines on which considerable experience has been gained.

Contributed by the Oil and Gas Power Division and presented at a meeting of the Cleveland Section, Cleveland, Ohio, May, 1945, of The American Society of Mechanical Engineers.

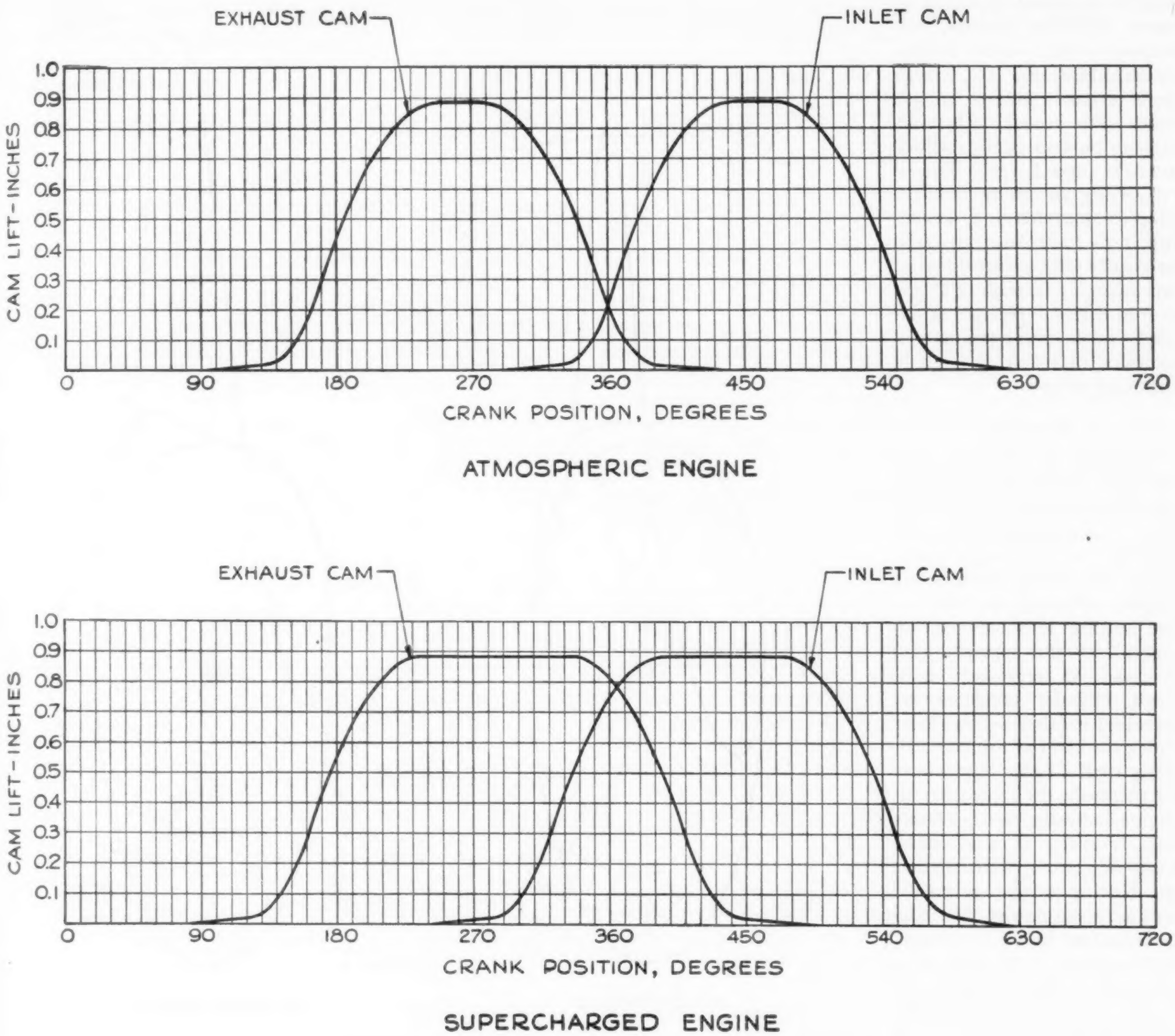


FIG. 1 CAM-LIFT CURVES FOR ATMOSPHERIC AND SUPERCHARGED DIESEL ENGINES

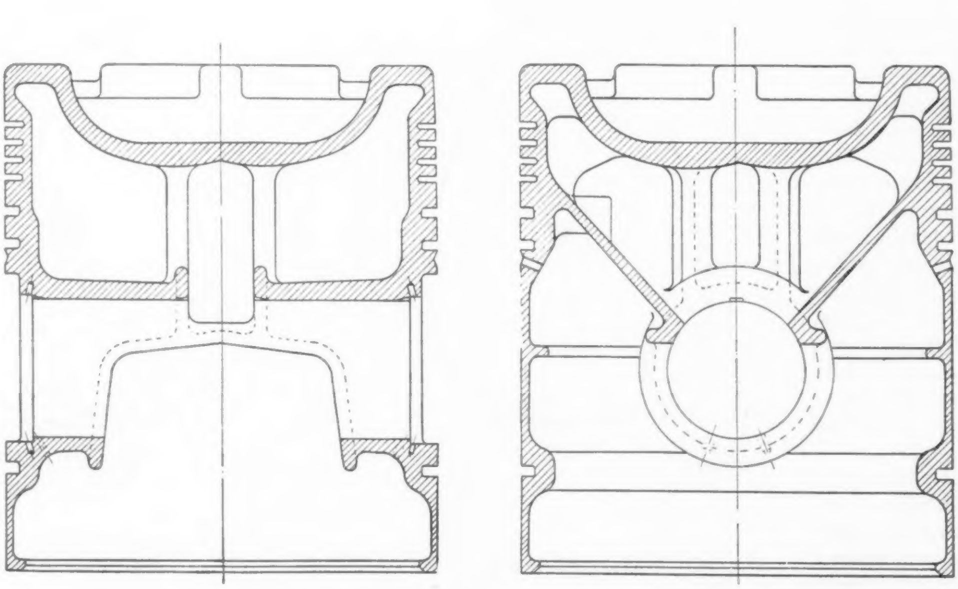


FIG. 2 EXAMPLE OF EFFICIENTLY COOLED PISTON

itself in increased stresses of all parts, including pistons, connecting rods, main frames, shafts, bearings, etc. Such peak pressures are, of course, taken into account when designing modern engines which are to be supercharged. Even if converting an atmospheric engine to supercharging, assuming it to have been designed originally with reasonable conservatism, an increase of 15 per cent in cylinder pressure is not likely to be of any serious consequence in reflecting itself in increased stress.

BEARINGS

Sometimes bearings of existing engines have been found inadequate to permit supercharging. This is largely because the bearings were probably inadequate even on the atmospheric engine, although the duty on the bearing is somewhat increased by the supercharging process. As previously indicated, cylinder pressures are increased and there is some more shock load in the form of suddenly applied cylinder pressure. Furthermore, the supercharged-engine indicator card is a fatter one, resulting in a sustained load. We know, of course, that the bearing pressure permitted on any given design of bearing is dependent in large measure on how long that pressure is sustained. With engines of moderate or high speeds, detailed analysis of the area of the pressure-time diagram of the bearings shows that frequently this area is actually somewhat less with the supercharged engine than with the atmospheric type. This is, of course, because of the combination of more sustained load and inertia forces. At zero speed the pressure-time diagram has a greater area, about in proportion to the appearance of the polar diagrams incorporated with this paper. In general it may be said that most modern Diesel engines, particularly if they have the precision-type bearing and have been properly designed, have adequate bearings to permit supercharging.

A complete analysis has been made of various models of engines showing the relative bearing duty of the atmospheric versus the supercharged type. A typical analysis is presented

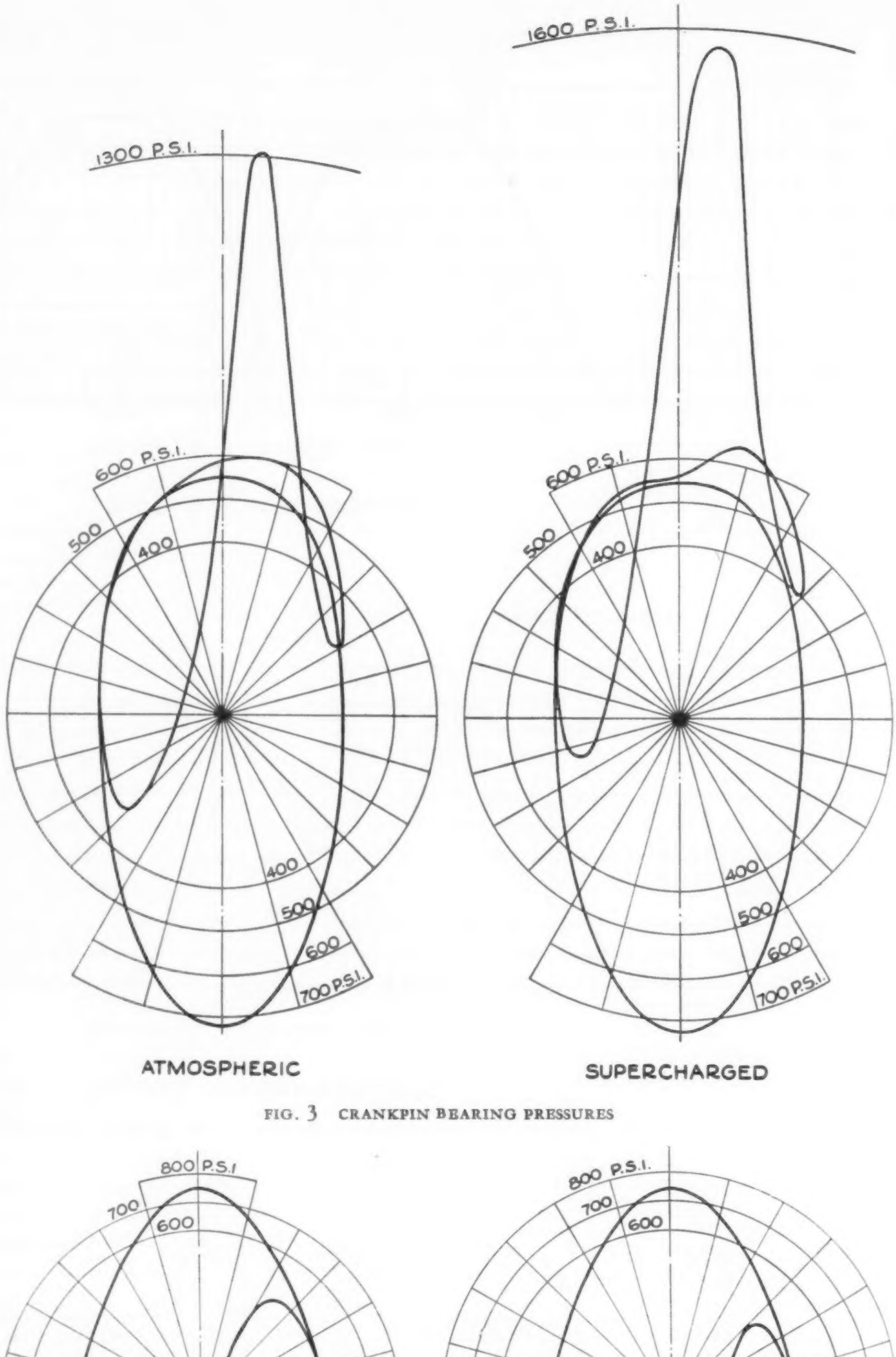


FIG. 3 CRANKPIN BEARING PRESSURES

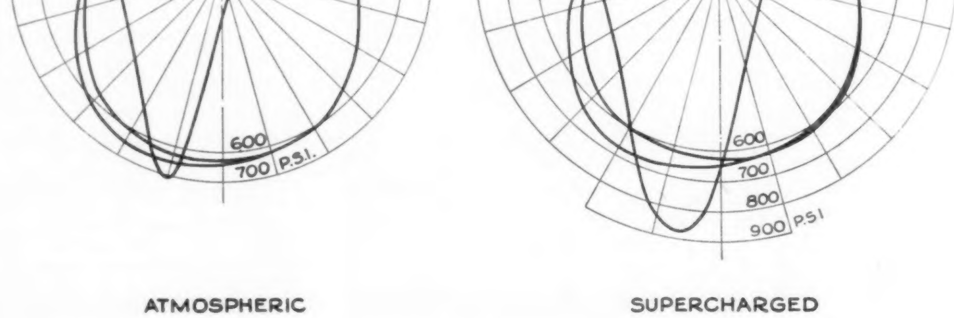


FIG. 4 END MAIN-BEARING PRESSURES; NOS. 1 AND 9

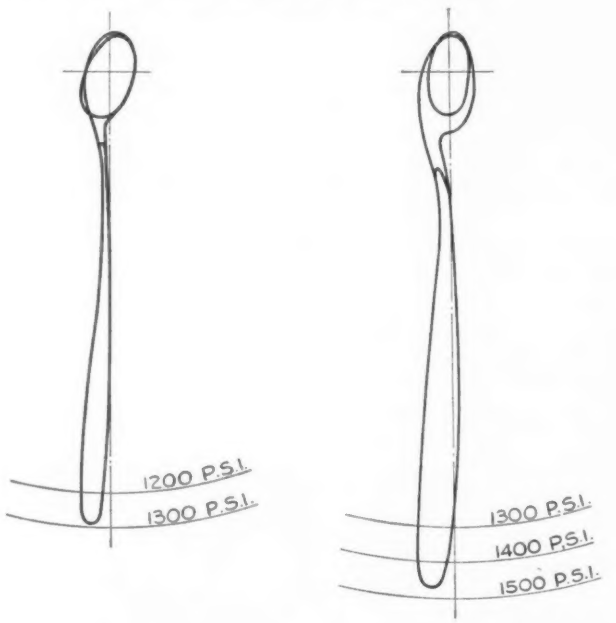
in Figs. 3 to 7, inclusive. Owing to the increased duty on the bearings, it is wise to provide increased oil flow to insure proper cooling.

HEAT DISSIPATION

Since the indicator card is fatter with more sustained pressure and temperature, it is logical that there should be increased heat rejection both to water and oil. However, it is gratifying to find that it is not increased nearly as much as the power is increased, and therefore the rate of heat rejection is materially reduced. To make a detailed analysis of this, a study of eleven engines was undertaken, five atmospheric and six supercharged. This analysis is presented in Table 1.

TABLE 1 RATE OF HEAT REJECTION AND HORSEPOWER INCREASE OF ATMOSPHERIC AND SUPERCHARGED DIESEL ENGINES

	Number of engines	Average bmep	Increase in hp, per cent	Average Btu per hp per hr to water	Bmep × Btu = K	Increase in Btu, per cent
Atmospheric	5	82.6	..	2482	205000	..
Supercharged	6	117.7	42.5	1841	217000	5.85



ATMOSPHERIC SUPERCHARGED

FIG. 5 MAIN-BEARING PRESSURES; NOS. 2, 4, 6, and 8

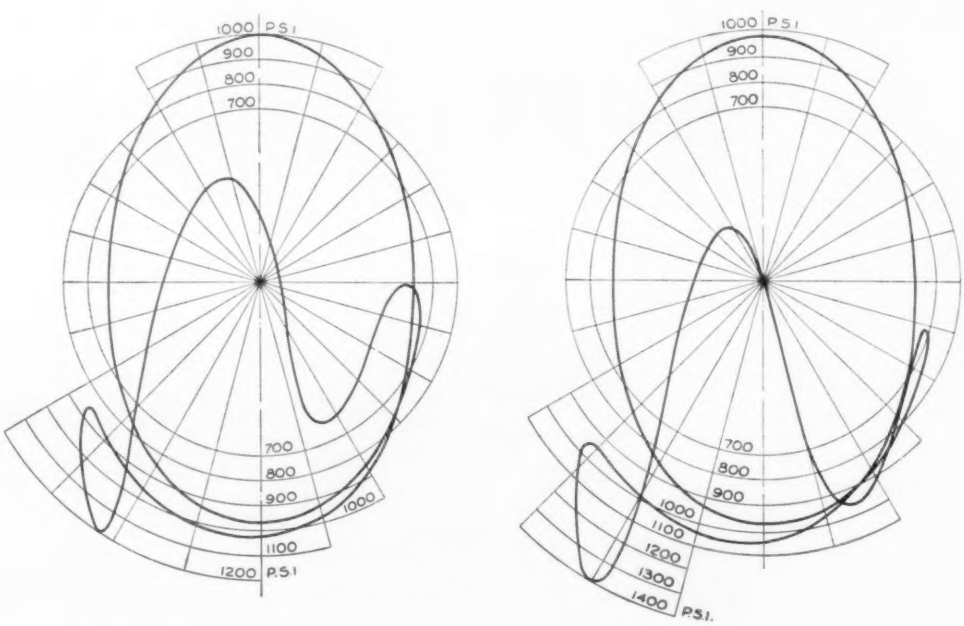
From this table it will be seen that the average increase in brake mean effective pressure or horsepower was 42.5 per cent. The over-all heat rejection, including lubricating-oil cooler and water jackets, was 2482 Btu per hp-hr for atmospheric engines, and 1841 for the supercharged engines. Table 1 therefore indicates that with a horsepower increase of 42.5 per cent the heat dissipation was increased only 5.85 per cent. This means that heat-dissipation equipment, with radiators or jacket water coolers, need not be materially increased for normal ratings of supercharging. In fact, assuming the heat-dissipation equipment was reasonably conservative in design, it should be adequate when changing over to supercharging. Water pumps present a similar situation, since the rate of flow need not be increased appreciably.

HEAT DISSIPATION TO LUBRICATING OIL

It is difficult to state properly the heat dissipation to lubricating oil in the atmospheric versus supercharged engines, because of variations in piston design. The rate of heat dissipation to lubricating oil is highly dependent on the type of piston design, and since the supercharged engine always has a different piston it is difficult to make an exact comparison. Data collected from a large number of engines, however, indicate that the heat flow to the piston is increased about in proportion to the general heat dissipation indicated in Table 1, although in some cases it is somewhat greater.

FUEL CONSUMPTION

The fuel consumed in pounds per brake horsepower per hour is reduced on the supercharged engine, as compared to the atmospheric. A study of a large number of engines going over the test floor reveals that the average atmospheric engine consumes 5 per cent more fuel per horsepower-hour than the average supercharged engine, but it is apparent that a fuel system



ATMOSPHERIC SUPERCHARGED

FIG. 6 MAIN-BEARING PRESSURES; NOS. 3 AND 7

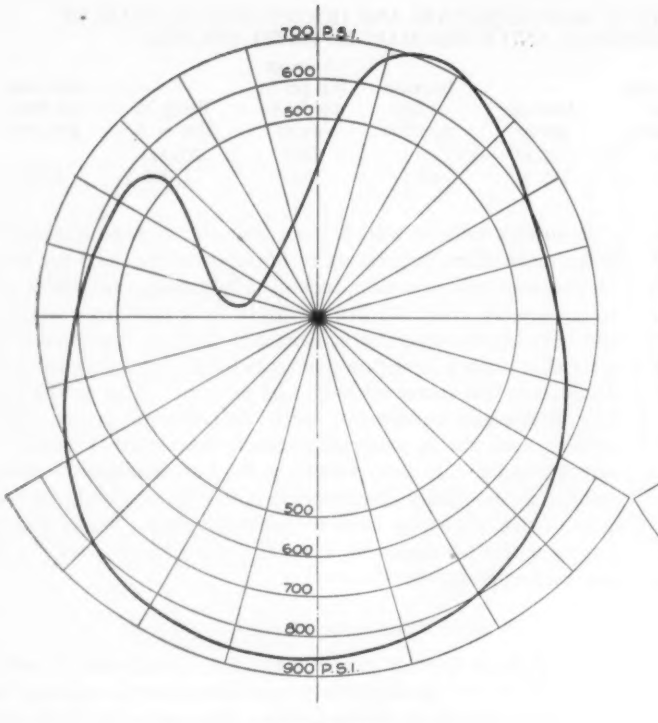


FIG. 7 CENTER MAIN-BEARING PRESSURES; NO. 5

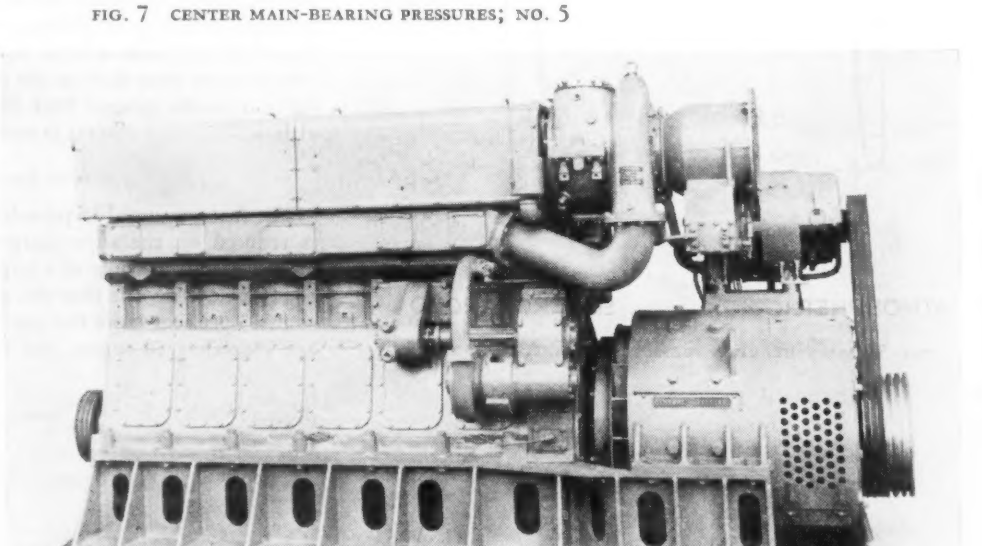


FIG. 8 INSULATED EXHAUST MANIFOLD

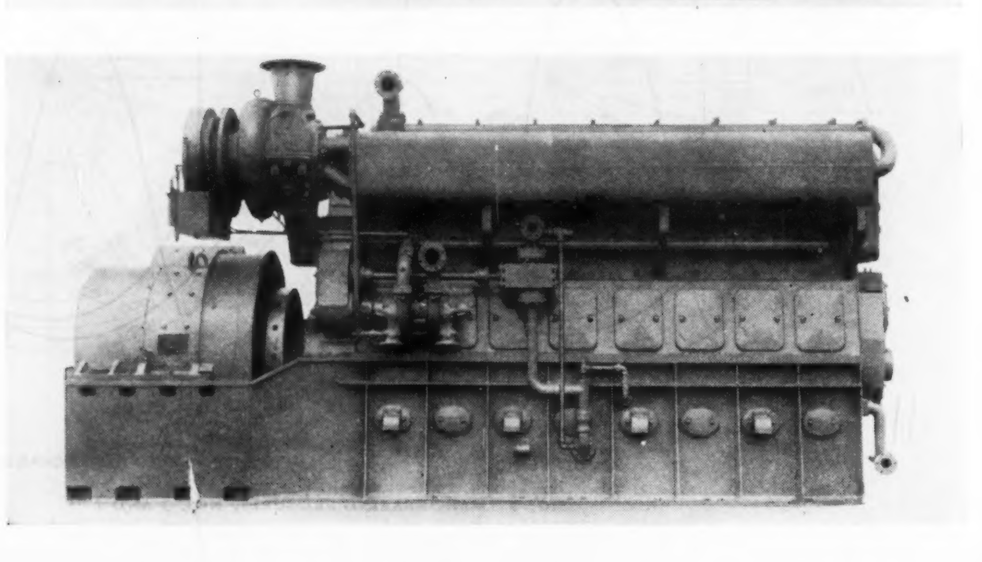


FIG. 9 WATER-BLANKETED EXHAUST MANIFOLD

designed for an atmospheric engine is not adequate for the same engine when supercharged. Not only must the fuel system itself be designed to handle the increased quantities, but fuel-handling means, such as supply pumps, etc., must also be increased in capacity.

MANIFOLDING

Details of exhaust manifolding, including the subdivided, have been adequately presented in other papers. The means of cooling this exhaust manifold, however, deserves some attention. It was originally thought that, since all possible energy was needed in the turbine, the exhaust-manifold piping should not be cooled, but should on the other hand be insulated. While that is theoretically true, actually the amount of heat removed by cooling these manifolds is not of any serious consequence to the turbine and does not materially increase fuel consumption. The first applications of turbocharging were therefore by means of insulated pipes, and it was found that, in spite of such insulation, the heat rejection to the atmosphere is quite objectionable. In many cases, the entire assembly was then placed inside another insulated box. Such an arrangement is shown in Fig. 8. Even this design was none too satisfactory, because not only was there considerable heat rejected to the atmosphere, but it was quite difficult to dismantle any part of the exhaust manifolding under these conditions.

To correct this situation, a manifold was designed which had a water jacket around its exterior but which permitted the exhaust pipes to remain without having actual contact with water. This manifold entirely overcame the objection of the heat in the engine room, since its water jacket picked up all radiated heat. At the same time the amount of heat picked up was relatively small and turbine performance was found to be in every way equal to that with the insulated pipes. This type of manifold is shown in Fig. 9.

Since developing this so-called water-blanketed manifold, experiments have been conducted on direct water cooling. While it is found that the fuel consumption is increased slightly and turbine performance is not quite up to standard, the water jacketing actually had a far less detrimental effect than we had been led to suppose. However, the water jacketing gains nothing over the blanket type and does considerably increase the rate of heat rejection to the water, which of course is undesirable since means must be provided for dissipating this heat.

The intake manifold requires comparatively little attention. The intake manifold which is sufficiently large for the atmospheric engine is, in general, of sufficient size for the supercharged engine. Naturally, it is important to provide turns as smooth as possible with a minimum of abrupt change of direction, but that is equally important in the atmospheric engine.

SILENCING

All types of supercharging have been subjected to some criticism from the noise aspect. In the case of the turbo-blower, the air intake must be silenced to some degree, although that is usually supplied with the blower itself. It was found, however, that one of the most prolific sources of noise was the intake manifold of the engine into which the blower discharged. The design of this manifold is important; a round section being ideal, and a cast manifold being considerably better from the noise-producing standpoint. However, owing to the desirability of weight saving, this manifold is usually of welded steel and frequently cannot be round in section. It has been found that insulating material over this manifold is very effective in reducing the sound level materially. With the latest type of blower-impeller design, together with this insulating means, it may be truthfully stated that the supercharged engine is not particularly noisier than the atmospheric type. From the exhaust-silencing standpoint, the supercharged engine is greatly superior. In fact, exhaust noise from the discharge of the turbine itself is not especially objectionable, and it is usually unnecessary to install any additional silencers such as are always necessary on the atmospheric type.

It is apparent that while it is possible to supercharge an existing engine, merely by changing its timing and perhaps piston contour, the builder should not be too optimistic about the results to be expected when converting an engine that was primarily an atmospheric type. Better results can be assured when design considerations are taken into account.

Making Standard Cast Models in Rubber Molds

(*Continued from page 386*)

on the metal at the outer edge of the cavities, and the cover of the safety box being closed, the metal is poured in through a wooden funnel attached to the cover. An alloy which gives clear, sharp castings when poured at 500 to 600 F, according to the thinness of the pieces, consists of 98 per cent tin, 1 per cent copper, and 1 per cent antimony.

After pouring, the mold is allowed to spin for 30 sec while putting back the ladle, the switch is thrown off, and when the machine stops, the mold is parted and stripped. It is again lightly dusted with fine talc, any loose talc being blown away, then set together and re-used. Practice will enable 25 pours per hr to be made on light sections on one machine, and one operator should be able to run two machines. Porous and incomplete castings usually result from trapped air and can often be corrected by venting. This may be done with a 40 to 45 twist drill in a hand drill, putting fine vent holes at critical points. Soap water will lubricate the drill if it tends to bind or choke in the rubber.

RESULTS ACHIEVED

The method has been successfully used for several years for making light intricate castings with smooth surfaces, both in small and large quantities. It offers a means of doing this at low cost with small investment. Only a single, positive pattern is required, and from this any number of molds can be quickly made. When properly compounded stock is used for these molds, a pouring temperature of not over 550 F is found to be sufficient, and undercuts are light, 500 to 600 pours have been obtained.

These molds will not be found adaptable to all castings. Dimensions may not be of micrometric accuracy, and slight distortions may occur, but it would appear that the method should be helpful to the purpose in hand, that is, the making of scale models for plant-layout purposes, in moderate quantities and at low over-all cost.

ACKNOWLEDGMENT

This description of one method of practicing the art of casting in rubber molds is presented at the request of Mr. G. E. Hagemann, Chairman of the Materials Handling Divisions of the Society.

The author is greatly indebted to Mr. Frank K. Smith, president of Technic Inc., of Providence, R. I., for general and specific information concerning the procedures.

How Can CHINA *Be* INDUSTRIALIZED?

BY K. Y. CHEN

ASSISTANT CHIEF, FAR EASTERN DIVISION, UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION, WASHINGTON, D. C.

IN recent months the possibilities of industrializing China have inspired widespread discussion among Chinese and also among Americans. At a meeting of this Society, in 1944, I discussed the requirements of industrialization which would tend to raise the standard of living of the Chinese population.[1] Since then numerous papers have been published on the subject.

The Engineering Service of the Foreign Economic Administration, under the direction of Mr. Alex Taub, chief engineer, has gone so far as to prepare a detailed guide to the industrialization of China, including various projects totaling over 600 factories, plants, and transportation facilities and costing billions of dollars.[2] Mr. John Savage, chief designing engineer of the Bureau of Reclamation, Denver, Colo., has designed a 10,000,000-kw hydroelectric plant[3] for the upper Yangtze, which would cost $1,000,000,000. The "China-America Council of Commerce and Industry" has held many committee meetings to discuss the industrialization of China. I recently attended a conference of the Institute of Pacific Relations at which several sessions were devoted to the postwar economic development and industrialization of China. Inquiry is frequently made as to the borrowing capacity of China from the friendly nations, and the methods to be used to secure sufficient funds to accomplish such a large-scale development.

I approach the problem with which China is confronted as an individual who is desirous of purchasing a farm and yet has not sufficient savings or equity to permit a cash payment for the entire amount. This individual, with an income and with deductions for current expenses, has a definite surplus or savings each month. He contacts a bank or building and loan association and negotiates a loan for the desired amount, agreeing to pay back the loan, as well as the interest charges, by a monthly installment-payment plan. On the date of final payment, the farm is finally owned outright and his income and savings will rise. By the same procedure, the needs of China as a nation can be procured.

FIVE-YEAR PLAN

Now let's see what China urgently needs for the postwar reconstruction in the first five years. Before deciding on a program, I would like to quote a passage from Confucius' Dialogues.

"Tze Kung asked about Government. The Master said, 'The requisites of Government are that there be sufficiency of food, sufficiency of military equipment, and the confidence of the people.'

"Tze Kung said, 'If it cannot be helped and one of these must be dispensed with, which of the three should be foregone first?' 'The military equipment,' said the Master.

"Tze Kung again asked, 'If it cannot be helped and one of the remaining two must be dispensed with, which of them should be foregone?' The Master answered, 'Part with the food. From of old, death has been the lot of all men, but if the people have no faith in their ruler, there is no standing for the State.'"

In principle, Confucius advocated the idea that a government which has the confidence of its people ought to "feed" them first and "arm" them next, i.e., in modern language, to raise their standard of living first and build the national defense next, i.e., welfare economy first and power economy next.

It is interesting to note that this teaching of 3000 years ago conforms with modern economic views. Dr. Eugene Staley, in his recent book "World Economic Development" said, "In the early stages of economic development, industrialization is likely to manifest itself in (1) increased processing of local raw materials, including processing for export, (2) manufacture of simple consumption goods, (3) assembly of products using imported parts, (4) utilities and their maintenance. In later stages the heavy capital-goods industries take on increased importance. This is the usual sequence and the one likely to be easiest and also most immediately effective in raising living standards."

The industrial development of Japan without regard to the improvement of living standards of the people has led Japan to disaster. The Soviet Union, with some light industries to begin with, has pushed capital-goods industries ahead of light industries, but has postponed the raising of living standards. The Chinese living standard is too low to be neglected in her economic development in the postwar era.

With these principles in mind, I have studied Dr. Sun Yat-Sen's "International Development of China" and Generalissimo Chiang Kai-Shek's "China's Destiny," and have drawn up a plan for the first 5 years of postwar industrialization of China. Table 1 is the result of my study, and the developments indicated will amount to approximately $10,000,000,000 (United States currency).

In this table it will be seen that as much as 52 per cent is devoted to transportation and communications, 16 per cent to improve farming and furnish consumers goods, 17 per cent to public utility and public health, and another 15 per cent to fuel and iron works to furnish the necessary raw materials for industrialization. This program aims at raising the living standards of the people.

Improvement of transportation and communication is recognized as an absolute necessity. Just for example, before the war one Chinese dollar would buy 5 Sunkist oranges in Shanghai, but the same Chinese dollar would buy, in Chungking, 100 locally produced oranges which are sweeter, bigger, and juicier. But because of the lack of transportation, the indigenous, i.e., native or Chinese oranges, could not be shipped to supply the needs of the people in Shanghai. The same thing happened with tangerines. In Shanghai we could buy 20 for one Chinese dollar, while in interior Province of Hunan, one cent would buy 20 of the same quality. Without modern transportation, Chinese farm products can be moved from place to place only by ox carts, horse and wagon, hand carts, or human carrier. The time consumed by other than modern transpor-

[1] "What Postwar China Hopes for From U. S. Engineers," by K. Y. Chen, MECHANICAL ENGINEERING, July, 1944, pp. 456–458.

[2] "China to Use F.E.A. 5-Year Plan," *Washington Post*, Jan. 7, 1945.

[3] "Big Hydro-Electric Plants for Upper Yangtze," *The Chinese Nationalist Daily*, New York, N. Y., Feb. 9, 1945.

Presented at a Meeting of the Baltimore Section, Baltimore, Md., February 26, 1945, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

TABLE 1 FIVE-YEAR $10,000,000,000 ECONOMIC PLAN FOR CHINA

	Unit and cost	Total cost
Transportation and Communication:		
Railway	20,000 miles at $60,000 per mile	$ 1,200,000,000
Highway	150,000 miles at $8000 per mile	1,200,000000
Ships	5,000,000 tons at $200 per ton	1,000,000,000
Motorcars	500,000 units at $2000 per unit	1,000,000,000
Telecommunication	....	500,000,000
Air-lines and airplane factories	....	300,000,000
Public Utility and Health:		
Hydroelectric power plants	10,000,000 kw	1,000,000,000
Water, sewage, etc.	....	300,000,000
Hospital equipment and supplies	....	400,000,000
Consumer Goods:		
Flour mill (100 lb of flour per capita per year)	75,000 tons per day at $1000 per ton of machinery	75,000,000
Rice mill (500 lb of rice per capita per year)	375,000 tons per day at $100 per ton of machinery	37,500,000
Spindles	15,000,000 spindles at $40 per spindle	600,000,000
Building-material plants, such as cement, brick, saw mills, glass, paint, etc.	....	200,000,000
Miscellaneous plants such as sugar, soap, oil, paper, etc.	....	200,000,000
Farm goods plants, such as fertilizer, insecticides, veterinary supplies, etc.	....	500,000,000
Coal mines and iron works	....	1,500,000,000
Grand total		$10,012,500,000
Say		$10,000,000,000

tation is much too long for handling perishable goods, including fresh fruits and vegetables.

For the transportation of rice and piece goods, the price added due to transportation can be easily illustrated by an example as given by Mr. John E. Baker. One man can carry 80 lb of rice 15 miles a day. He consumes about 2 lb for his supply of energy per day and therefore would have consumed his own load at the end of 40 days. That means his load is only enough for his own consumption for a round trip of 300 miles. If he has a family of 4, a wife and three children, to be supported by him, the consumption of food would have been 10 lb per day and his load only enough for the subsistence of himself and his family for 8 days in making the round trip. Therefore, the price of rice would have to be doubled at a journey equivalent to 4 days at 15 miles a day, i.e., 60 miles from the point of origin. So at every 60 miles the price of rice will be doubled. The local production therefore cannot go very far by man carrier. It is evident that this is the most costly method of transportation.

We have small rivers and small boats to carry heavier loads, and some country roads which are suitable for animal carriers, but the cost of transportation, in comparison with modern transportation, is tremendous and the deficit areas cannot expect to be supplied by surplus areas. The necessity of having modern transportation equipment is evident.

The lack of adequate public utilities, similar to the lack of transportation, is a tremendous handicap in China. Without an efficient water-supply system the sanitary conditions are lacking, and public health is endangered. Then too, we do not have enough hospitals in China. The figure in 1944 showed that we have altogether 38,834 hospital beds. We need at least 90,000 additional beds, i.e., one bed for 5000 people, which is very low compared with the United States which has one bed for each 90 people.

Consumer goods produced before the war were not sufficient for distribution. The spindles in China can supply only one quarter of the requirements of Chinese clothing on a basis of 10 sq yd per year per capita. The consumption of 10 sq yd per year per capita is very low compared with American consumption. The yearly consumption per capita in the United States averages 65 sq yd, including sheeting, tablecloths, napkins, towels, aprons, dish towels, etc., while the "Bombay Plan" expects to furnish the Indian population 30 sq yd per year per capita.

China is an agricultural country. Every effort should be made to increase the production of farms and eliminate the unfavorable conditions which tend to decrease the production. Floods must be prevented, plant diseases and animal diseases should be checked, the method of cultivation should be improved, fertilizer plants should be installed and farmers encouraged to use fertilizer. Finally, coal mines and iron works should be operated extensively in order to supply the necessary fuel and iron for the transportation system and various industrial plants.

So, the $10,000,000,000 plan is a minimum plan and for the good of the people should be carried out as soon as the war is over. Now the question is: How is China going to service the $10,000,000,000 capital?

CHINESE CAPACITY TO BORROW

In order to service the $10,000,000,000 capital, we want to know the potential financial ability of China in foreign exchange.

Table 2 shows the present foreign-exchange assets and estimated sources of foreign exchange of China. The first three items are selected from "China Foreign Trade," 1937, and amount to $225,766,000. The total export for that year was $248,326,000. Only those items which have permanent demand and have a tendency to increase are selected.

Item 4, "Manchurian exports," is taken from "Foreign Commerce Year Book," 1938. The total import for that year was $279,935,000 for China proper and $255,486,000 for Manchuria. The items are chiefly consumer goods, machinery, and finished goods. The former will be supplied by local production and the latter will be replaced by the imported machinery and equipment under the $10,000,000,000 plan. Item 5, "overseas Chinese remittances" was taken from H. D. Fong's "The Post-War Industrialization of China." According to him, the 1936 figure was $110,000,000, as given by the Bank of China; the 1939 figure was $225,000,000, as given by the leading Chinese paper "Ta Kung Pao." Item 6 is estimated. The total yearly foreign-exchange asset is then $610,766,000.

After the war the export of antimony and tin might be slightly reduced but tungsten ore will not drop very much. Agricultural exports, after China has improved farm methods and eliminated unfavorable factors such as flood, parasites, etc., will be greatly increased.

Americans and Europeans find desirable the products of Chinese handicrafts, especially embroideries, laces, chinaware, lacquerware, and bamboo products. These articles have been home products, but due to the lack of transportation and organization, only a small fraction has been exported. These handicraft industries will have to be maintained and promoted after the war and will be immensely increased due to the release of manpower from other activities, which will be replaced by modern transportation and consumer-goods industries.

TABLE 2 TOTAL CHINESE YEARLY FOREIGN EXCHANGE

Ores, metals, and metallic products exports:	$ 34,000,000
Iron ore, wolfram (tungsten) ore, antimony regulus, tin ingots and slabs	
Staple agricultural exports:	
Textile fibers (raw cotton, hemp, ramie silk, camel wool, goat wool, sheep wool	43,000,000
Oils, tallow, and wax (groundnut oil, tea oil, wood oil)...	42,000,000
Animals and animal products* (bristles, eggs and egg products, intestines)	41,000,000
Hides, leather, and skins or furs (buffalo and cow hides; goat skins, undressed; lamb skins, dressed and undressed; weasel skins, dressed and undressed)	18,000,000
Seeds (groundnuts, in shell; groundnuts, shelled; apricot seed; linseed seed; seasamum seed; seeds, miscellaneous)	12,000,000
Tea (black, Congou; black, other kinds; brick, black and green; green, gunpowder; green, Hyson; green, young Hyson; green, other kinds)	10,000,000
Beans and peas	2,000,000
Total	$168,000,000
Handicraft Exports:	
Embroideries, laces, handknitted, etc.	$16,000,000
Chinaware, etc.	1,560,000
Bamboo products	990,000
Rattan products	53,000
Straw braid	615,000
Straw hats	2,188,000
Umbrellas	443,000
Lacquerware	100,000
Mats and Matting	1,477,000
Leather trunks	340,000
Total	$ 23,766,000
Manchurian exports	$185,000,000
Overseas Chinese remittance	150,000,000
Expansion of travel service (religious and cultural support from friendly nations)	50,000,000
Grand total	$610,766,000

* Not including hides, leather, and skins (furs) and fishery and sea food.

Even without much increase, the amount of $610,766,000 is enough to service a capital of $8.7 billion at an annual interest of 3 per cent and an amortization of 4 per cent.

China cannot expect to carry out the $10 billion project in one year, so she does not expect to have the machinery and equipment within the first year. When it is distributed over a five-year period it is evident that the $10,000,000,000 capital will be fully and adequately serviced.

INTERNAL EXPENSE

With $10,000,000,000 worth of materials and equipment, what will be the cost of local material and labor, and how will these be provided? Generally, the internal expense is 40 per cent of the total project. The present $10,000,000,000 plan will require $6,500,000,000 for local material and labor. Spreading over 5 years, it needs $1,300,000,000 per year. Dr. C. C. Wu, secretary-general of the Chinese WPB recently in presenting a paper, "Plan for China's Industrialization," said, "It does not seem unreasonable to expect our postwar savings to increase to 1.3 billion American dollars." If this saving can be used exclusively for industrialization it will just meet the internal expense of the $10,000,000,000 plan.

Mr. Lawrence K. Rosinger, in his paper "China as a Postwar Market" published in "Foreign Policy Reports" January 1, 1945, said, "In the course of the Far Eastern war, the U. S. Government has lent China $670,000,000 and Britain has extended loans totaling £68,500,000. Of the former, about $300,000,000 may be left at the end of the war, and perhaps £25,000,000 (about $100,000,000) of the British credits will be available....... In addition, significant sums of money have been sent abroad by wealthy Chinese as part of a wartime flight of capital,......estimated at between 300 and 400 million U. S. dollars." The total cash is between $700,000,000 and $800,000,000. There is no doubt that some of the cash will be available for economic development of China.

CONCLUSION

What has been said is an engineer's view of a simple scheme for improving Chinese economy in the first five years after the war. After it has been accomplished plans for further development can be drawn.

Engineers will have an ever-important position in promoting the economic construction of China and raising the standard of living of the Chinese population necessary to lay the sound foundation of true democracy in China.

I have a conviction that the Chinese Government, after experiencing difficulties through these years of war, will spare no effort in strengthening itself to achieve internal political stability. I have also a conviction that the Chinese people, struggling for bare subsistence for centuries, will exert themselves to the utmost in helping to build a national economy just as they did with bare hands in building a B-29 air field in 3 months, and a 200-mile stretch of the Stilwell Road in 50 days. I have further a conviction that the United Nations will establish some system of world political security as manifested by the Dumbarton Oaks Conference, so that China may not be invaded again in the near future; that international co-operation for promoting economic development will be forthcoming as manifested by the Bretton Woods Conference so that China's plan for economic development may be carried out successfully.

As Mr. Alex Taub predicted, "As China goes forward industrially, she will make tremendous and ever-growing imports of equipment.......Later, the coolie, as well as his nation, will become a customer for more and more of the world goods." The economic development of China is to increase the capacity of her 450,000,000 population to produce as well as to consume.

In concluding, I may add that China is a potential country, not loaded with debts, which with a little help to get started, will sail on peacefully and prosperously.

ENGINEERING colleges must improve their programs of study so that their graduates are more competent to deal with the application of the engineering method to the research, development, design, and production problems of industry. At the same time engineering-college graduates must have a better appreciation of their duties as citizens in a democracy and a keener interest in economic problems and in social trends. The engineer of tomorrow must realize that better gadgets in themselves do not make for happy living. He must have a deep appreciation of the social consequences of his creations; he must think more, write more, and talk more on social and economic questions in order to assist in the solution of the major problems which are confronting humanity. The engineering student must take an active interest in government and politics, realizing that his contributions to society will be lost without stable government. He must work for good government and must apply clear thinking and courageous action to matters which concern the public. All patriotic Americans must realize that our country's future depends upon the extent to which the most able, best educated, clearest thinking, and most courageous of our citizens are willing and ready to take an active part in public affairs.

Difficult and uncertain times are ahead of us.......Those of us who are responsible for engineering education and technical training for industry have now before us a challenge to educate for good citizenship and to stimulate the abilities of our students to invent and improve, while conditioning their character so that their human understanding and their social thinking will keep pace with our progress in science and engineering. —A. A. Potter, past-president, A.S.M.E., in an address at the 25th Anniversary of General Motors Institute.

The ENGINEER'S STATUS *in the* COMMUNITY

By ROY V. WRIGHT

PAST-PRESIDENT AND HONORARY MEMBER A.S.M.E.; CHAIRMAN, A.S.M.E. ENGINEERS' CIVIC RESPONSIBILITIES COMMITTEE

THE engineer, without question, has been instrumental in conferring great material benefits upon mankind. That all of his endeavors have not been so well directed is evidenced by the present terrible destruction of life and devastation of property in the war zones. Certainly we engineers, like all other citizens in this great Commonwealth, have definite duties and responsibilities, even though we have not been well educated and trained to recognize and discharge them. Certainly also, beyond that, as men who have had so important a part in making possible this industrial and mass-production era, with its high standards of living, we should at least make a reasonable effort to be helpful in finding solutions to some of those problems which have been introduced or greatly intensified as the result of our efforts.

THE ENGINEER AND GOVERNMENT

We must not forget the significant statement made by President Herbert Hoover in responding to the presentation of the first Hoover Medal in 1931. Let me quote from it:

> These great discoveries and inventions have brought great blessings to humanity, but they have multiplied the problems of government, and the complexity of these problems progresses with the increase of our population. Every county government, every municipal government, every state government, and the federal government itself, is engaged in constant attempt to solve a multitude of public relationships to these tools which the engineers by their genius and industry constantly force to the very doorstep of government. And in solving these problems we have need for a large leavening of the engineering knowledge and engineering attitude of mind and engineering method. These problems of public relation are unsolvable without the technical knowledge of the engineer.

Grant, if you will, that this entails the rendering of professional services for which engineers should receive adequate compensation. Beyond this, however, engineers, individually and collectively, like all other citizens, must do their full part in helping to elevate and maintain high standards of honest, efficient, and effective governmental administration. Like other responsible citizens they should study how to make their influence most effective to achieve these ends. Their background, training, and experience fit them to render exceptional service in this respect.

"ETERNAL VIGILANCE"

There are certain truths which have been passed down to us through the generations, the expression of which has become so trite and commonplace that they fail to impress us. There is no greater truth than "eternal vigilance is the price of liberty;" and yet, so long has it been a copybook maxim that its statement fails to challenge us adequately. We recite it glibly, but it fails to penetrate our thinking. We are so sure of the stability of our type of government that we are not concerned with studying the reasons for the failure of democracies, ancient or modern.

Nor are we concerned, as a people, with the fact that the distractions of modern life and the growing complications of governmental machinery have tended to make us indifferent to our responsibilities as citizens and that we are slowly, but steadily, drifting toward the edge of the precipice. One cannot but be dismayed, for instance, as we study the voting habits of our citizens, or the power of modern malicious propaganda.

The late Hendrik Willem van Loon was greatly concerned about these trends and pointed out that Plato said 2500 years ago that autocracy was the result of bad democracy. The thinking of the American public was clearly reflected in the decision of van Loon's publishers not to bring out his splendid series of syndicated newspaper articles on "The Story of Democracy" in book form, because the public seemed so little interested that they feared to assume the financial risk.

ENGINEERS' CIVIC RESPONSIBILITIES

It was considerations such as this that caused The American Society of Mechanical Engineers several years ago to set up a committee that is now known as the Engineers' Civic Responsibilities Committee. It has approached the problem from several angles and has stimulated a certain degree of interest. Progress, however, has been slow.

Before we discuss the work of the committee, let us consider some of the developments taking place in engineering education, which promise to enhance the status of the engineer and make him a more important factor in the community.

A committee of the Society for the Promotion of Engineering Education recently made a report on Engineering Education After the War, which has attracted an unusual amount of attention. One direct result of this report has been the formation of a Humanistic-Social Division of that society. That phase of engineering education was emphasized in a report of the Committee on Aims and Scope of Engineering Curricula in 1940. It is now suggested that a minimum of 20 per cent of the students' educational time should be devoted to such studies. It is significant to us in this discussion that part of the recent report relating to humanistic-social studies is concerned directly with responsibilities of citizenship.

Let me quote a few sentences from this section:

> The duty of citizenship in a democratic society is one which an engineer may fulfill in part as an individual and in part through his participation in the group activities of his profession and community. . . . . It seems clear that engineers, as part of this professional duty, must assume a more important share in shaping public policies and practices, and especially so in areas related to their work.
>
> Among the roles of citizenship, four aspects may be recognized:
>
> 1 Observance of laws and regulations.
> 2 Sustaining participation in government and in cultural activities.
> 3 Criticism and counsel.
> 4 Creative contributions as statesmen, thinkers, artists, philanthropists, and leaders of social movements.

THE A.S.M.E. COMMITTEE

As has already been pointed out, the officers of the A.S.M.E., recognizing the fact that engineers are not as mindful of their civic responsibilities as they should be, appointed a special

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Presented at a meeting of the Washington, D. C., Section of The American Society of Mechanical Engineers, Dec. 14, 1944, and of the Cleveland, Ohio, Section, Feb. 8, 1945.

committee to study the problem and take such steps as it could to remedy this shortcoming.

Naturally the committee turned its attention first to the possibilities of citizenship training in the student and junior groups. Among its more noteworthy efforts was the distribution to the junior members, through the generosity of the Newark College of Engineering, of the pamphlet, "The Engineer's Duty as a Citizen," used as the basis of a discussion course in that institution. The committee also made an effort to encourage engineering colleges to sponsor prize competitions on themes dealing with the engineer as a citizen.

Gradually, as the result of these experiments, and from continued observation and discussion, a more ambitious program was inaugurated. In October, 1943, a letter was sent to the honorary chairmen of the student branches asking for "comments and suggestions as to the most practical and constructive means of stimulating a greater interest in these matters (responsible citizenship) on the part of our student branches."

Replies were received from 19 of the 115 honorary chairmen. By far the greater proportion of this comparatively small number were sympathetic with the committee's objectives. There was a decided demand for speakers and program material.

THE COMMITTEE'S OBJECTIVES

At about the same time letters were sent to the chairmen of the 70 local sections asking them to designate an individual, or appoint a small committee, to co-operate with us in making a high-spot survey of each section to determine the extent to which the members of our Society are active in governmental or civic affairs, beyond professional work for which they are compensated.

The objectives were twofold:

1 It was the expectation that a number of civic-minded members could be located who would co-operate with us in making such a survey, and that this would pave the way for local sections programs dealing with the engineer as a citizen. This in turn would develop a more pronounced citizenship consciousness in the membership, both individually and collectively.

2 The engineering-college student can hardly be expected to take a keen interest in such matters unless he is challenged by the examples of older engineers who are actively engaged in civic affairs. It was hoped also that such engineers might be inspired to co-operate with the student branches in discussions of responsible citizenship.

MEASURING STICK FOR PUBLIC SERVICE

Replies were received from 27 of the 70 local sections and many of them designated members to work with us. In December, 1943, instructions were sent to these co-operating members asking them to make a rough survey of their sections and send us information about members rendering special civic service. It was accompanied by a so-called "Measuring Stick," which is as follows:

Following are some of the ways in which engineers—or other citizens, for that matter—can participate actively and constructively in civic affairs:

1 Appointive positions on public boards or commissions—local, county, state, or federal.

2 Elective offices—local, county, state, or ederal.

3 Political party organizations—as committeeman (precinct, ward, city, county, state, or national). As leaders or active participants in party organizations. (Such positions have unfortunately been left too largely to "professionals.")

4 Members of legislative committees in any type of organization. (In some instances they may be called "pressure groups," but they do a lot to assist, as well as keep a check on the legislator who needs coaching and checking, for with the multiplicity of problems which he must ace, he cannot be expected to have the necessary expert information to pass on all questions, and really needs help from his constituents.)

5 Leadership in civic or community associations or groups.

6 Outstanding leadership or performance in community welfare projects.

These headings are suggestive and not intended to be exhaustive. You may find other ways as you survey your community.

A SAMPLE SKETCH

This may have appeared formidable to some of the recipients, although we tried to make it as simple and easy as possible. Fortunately, a co-operating member in New Orleans promptly sent in a sample to see whether it was what we wanted. It was so good we quickly sent duplicates with a follow-up letter to our fieldworkers. Here is the sample sketch:

David W. Stewart, chief engineer of the New Orleans Public Service, Inc., is president (1944) of the Kiwanis Club of New Orleans, having served as vice-president in 1943. Among his other civic activities are vice-president of the Kingsley House Association Community Center (a social agency); city commissioner of the New Orleans Council of the Boy Scouts of America; chairman of the advisory board of the New Orleans Council of the Girl Scouts of America; member of the Members Council of the Association of Commerce; and member of the Young Men's Business Club.

RESULTS DISAPPOINTING

The results thus far, from a quantitative standpoint, are disappointing. Only 19 sketches have been received, and most of these are from two sections in which we apparently have citizenship-conscious members. The Committee on Local Sections which "feels this is a very laudable and important activity," points out "that the officers of the local sections are so busy, under present conditions, that it is difficult to get them to even carry out the necessary duties to keep the sections functioning, and almost impossible to ask them to assume other duties." It suggests that "it would probably be better to try to work nationally in this field at present, rather than attempting any connection through the local sections."

A friendly critic points out that two or three members of the national committee could easily have sat down around a lunch table in New York and listed many more than 19 members of the Society who have rendered outstanding public service. That is quite true, but the point is to get members throughout the country busy on the task. In that way only can we expect to make the membership as a whole more citizenship-conscious, and that is the task assigned to the committee.

WIDE RANGE OF CIVIC ACTIVITIES

The sketches we have thus far received designate a wide variety of activities. Members are participating in all sorts of worth-while civic and community affairs. Some of them are functioning on school or planning and other boards or commissions. A few have even gone into practical politics; for instance, we have a state senator in Indiana and the mayor of a village on Long Island.

Contrary to a mistaken impression, our aim is not to urge members to go into practical politics, much as that may be desirable. We do believe, however, that a citizen should have a knowledge of governmental setup and operations and of political machinery, if he is to know how he can make his influence felt most effectively. Of what avail is it, if we understand public problems but do not know how to get our servants (public officials and representatives) to follow the proper course for their solution?

The suggested measuring stick does not specifically mention church activities and we have been taken to task for that omission. That it is inferred, however, would seem to be indicated by the extent to which such activities are noted in the thumbnail sketches. Certainly we cannot have good citizenship without good character. The Church and related organizations are pre-eminently character-building institutions.

(*Continued on page 406*)

RADIAL RAKE ANGLES *in* FACE MILLING

1—*Continuation of an Investigation*[1] *on Cutter Characteristics*

By J. B. Armitage[2] and A. O. Schmidt[3]

INTRODUCTION

A MILLING cutter with negative radial rake angles requires more power at the machine spindle than the same cutter with positive radial rake angles. This statement holds true for conventional cutting speeds as well as for higher cutting speeds up to 1180 fpm.

A milling cutter with a 15 or 30-deg positive radial rake angle and with a negative radial rake angle at the cutting edge 1 to 2 times the maximum feed per tooth in width was found to be an effective cutter design. This type of cutting edge combines the inherent strength of negative radial rake angles at the cutting edge with the lower power requirements of positive radial rake angles.

This paper summarizes a continuation of tests previously reported.[1] In the earlier series of tests 2-in-diam cutters with two teeth and a maximum speed of 785 fpm were used, whereas 3-in-diam cutters with two teeth and a maximum speed of 1180 fpm were used in the tests reported herein. In each series of tests several positive and negative radial rake angles were investigated.

In the previous investigation, with 2-in-diam cutters, a number of conclusions were reached. The purpose of the present tests was to substantiate and amplify the range of conditions under which these conclusions would remain true. It was desired to establish the effect of negative radial rake angles on tool life and power consumption at the cutter. Also, additional information was to be obtained concerning performance of cutters with the double radial rake angle, the combination of a positive radial-rake-angle blade of 15 or 30 deg with a negative radial rake angle of prescribed width at the cutting edge.

In width, the negative angle is 1 to 2 times the maximum feed per tooth.

EQUIPMENT AND PROCEDURE

A Milwaukee 2K vertical milling machine as used in the former investigations was again employed. This permitted a close correlation of test data gathered over a period of 2 years. For the establishment of basic comparisons, 3-in-diam cutters, identical except for radial rake angles, Fig. 1, were used. A calorimeter[4] for this cutter was designed and the calibration checked, tabulated, and plotted graphically. In running the individual tests, observations were recorded on a data sheet. Included on this data sheet was pertinent information concerning the cutter, test conditions, and the test bar. Observations made at the beginning and end of each test cut included calorimeter temperature and surface temperature of the test bar measured, respectively, with a mercury thermometer and an Alnor low-range thermocouple. An Esterline-Angus recording wattmeter was connected to the milling-machine-drive motor for power-input determinations.

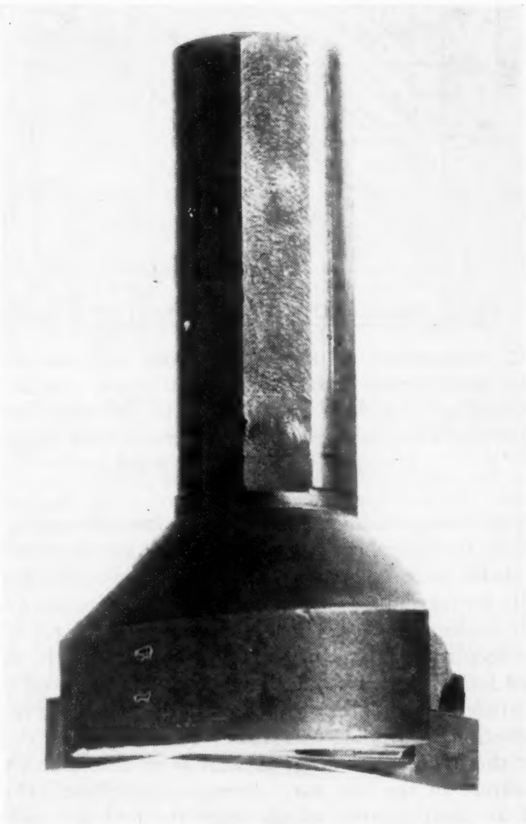


FIG. 1 CUTTER AS USED IN THE TESTS, WITH ADJUSTABLE SOLID CEMENTED-CARBIDE BLADES

Conclusions arrived at in this investigation were based exclusively on heat measurements of the calorimeter, from which the heat of the chips was determined. Test bars were cut dry, the chips falling directly into the circulating water. Calibration of the calorimeter was based on the first law of thermodynamics: When work is transformed into heat, or heat into work, a quantity of work is the mechanical equivalent of a quantity of heat.

DISCUSSION AND INTERPRETATION OF CALORIMETRIC TESTS

A 6-deg negative radial-rake-angle cutter was chosen for a series of tests in which cutting speeds were varied from 194 to 1180 fpm. In Fig. 2, each plotted point on the graph represents an average of no less than 3, and sometimes 6, test cuts. Errors due to motor and gear variations are excluded because power

[1] "An Investigation of Radial Rake Angles in Face Milling," by J. B. Armitage and A. O. Schmidt, Trans. A.S.M.E., vol. 66, 1944, pp. 633–643.

[2] Vice-President in Charge of Engineering, Kearney & Trecker Corporation, Milwaukee, Wis. Mem. A.S.M.E.

[3] Research Engineer in Charge of Metal Cutting Research, Kearney & Trecker Corporation. Mem. A.S.M.E.

[4] "Determining Tool Forces in High-Speed Milling by Thermoanalysis," by A. O. Schmidt, Mechanical Engineering, vol. 66, 1944, pp. 439–442; also, *Mechanical World*, Sept. 15, 1944, pp. 301–303.

Contributed by the Production Engineering Division of The American Society of Mechanical Engineers.

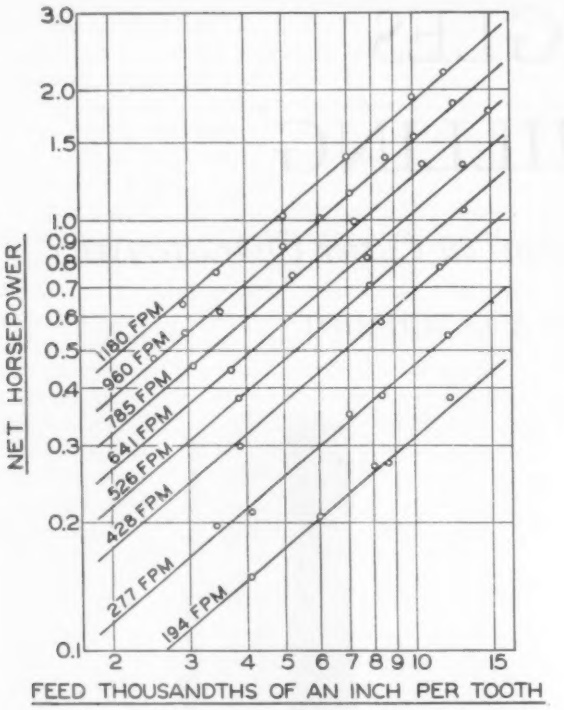


FIG. 2 COMPARISON OF NET HORSEPOWER REQUIREMENTS FOR CUTTER WITH 6-DEG NEGATIVE RADIAL RAKE ANGLES WHEN OPERATING AT DIFFERENT CUTTING SPEEDS, 0.125-IN. DEPTH OF CUT AND VARIOUS FEEDS; COMPUTED FROM HEAT IN CHIPS (Material S.A.E. 1055; Bhn 205.)

values are computed from calorimetric measurements. Test bars from the same heat were used throughout the tests. Carbide blades were not changed, they were merely moved out radially for regrinding. During the tests, the tips showed only minute evidence of wear when inspected with the aid of a six-power magnifying glass. If any slight chipping of the tips was noticed following a test cut, the cutter was removed because any further use would result in an immediate increase in power consumption. Chipping was readily detected by higher calorimetric thermometer readings as well as an increase in surface temperature of the test bar. Power-consumption values obtained at eight cutting speeds when the feed per tooth was varied were plotted on log-log co-ordinates, Fig. 2. These values for each particular cutting speed lie on straight parallel lines; therefore, horsepower consumption may be expressed as

$$\text{hp} = CnNf^a$$

where

C = constant based on cutting speed and rake angle
n = number of cutter revolutions per min
N = number of teeth in cutter
f = feed, in. per tooth
a = exponent determined as 0.87 from values plotted in Fig. 2

It was found that the value of C did not change at cutting speeds of 194 fpm and above, while at lower speeds it varied directly as the cutting speed. This can be attributed to the fact that at lower cutting speeds a greater percentage of the heat generated in the cut, i.e., the power consumption at the cutter, is absorbed by the workpiece and cutter.

At speeds below 194 fpm, machine vibration was noticed and chip structure was more segmented than at higher speeds.

Fig. 3 shows the power consumption of cutters with different radial rake angles when the cutting speed is constant at 1180 fpm and the feed rate varies. Since only 0.3 cu in. of metal was removed with each cutter tested, the cutters could be considered sharp for the short duration of the test. The 6-deg positive radial-rake-angle cutter has the lowest power consumption. As the radial rake angle decreases, i.e., when the angle is 0 deg, or 6 or 12 deg negative, the power consumption increases. A similar relationship holds true for cutting speeds of 960 and 785 fpm, Figs. 4 and 5. During all tests, it was observed that the 6-deg positive radial-rake-angle cutter exhibited a tendency to fail more quickly and frequently than the cutters with 6- or 12-deg negative radial rake angles.

Chip temperature and horsepower consumption per cubic inch of metal removed at 1180 fpm cutting speed are plotted in the upper portion in Fig. 6. These values were computed from the observed calorimetric temperature values, assuming a constant specific heat for the chips. Actually the specific heat of steel varies with an increase in temperature; corrections can be made for greater accuracy. It can be pointed out that the chip temperature and power consumption per cubic inch of metal removed per minute increases as the chip thickness decreases.

In the lower part of Fig. 6 are plotted workpiece temperatures measured with an Alnor low-range thermocouple immediately after the cut was completed. Workpiece temperatures, like chip temperatures, tend to increase as chip thickness decreases.

Similar chip temperatures, power consumption, and workpiece-temperature relationships were established for other cutting speeds. It was observed that for a constant feed per tooth, workpiece temperatures vary inversely as the cutting speeds.

EFFECT OF DOUBLE RADIAL RAKE ANGLES

From data plotted in Figs. 3, 4, and 5, it is apparent that negative radial-rake-angle cutters require more power to remove a given amount of metal than cutters with positive radial rake angles. This relationship remains constant as long as the cutting edges can be considered sharp. High cutting speeds will result in more wear on the cutting edge than will low speeds. Each cutter in this investigation was used to remove 0.3 cu in. of metal at cutting speeds above 700 fpm. In agreement with results of previous investigations, positive radial rake angles were found to consume less power than negative radial rake angles. However, a cutter with positive angles will fail more quickly than a cutter with negative angles and, consequently, bring about a more rapid increase in power consumption.

A combination of the two angles, a positive secondary radial

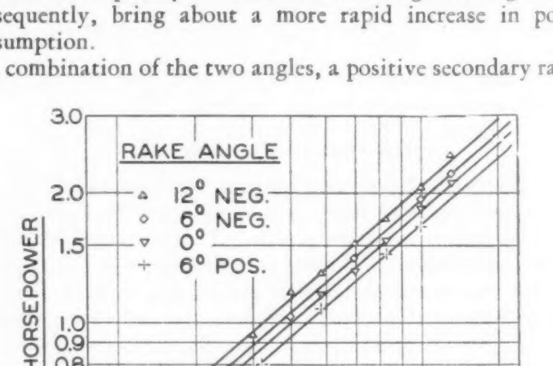


FIG. 3 COMPARISON OF NET HORSEPOWER REQUIREMENTS OF DIFFERENT RADIAL-RAKE-ANGLE CUTTERS AT CUTTING SPEED OF 1180 FPM, 0.125-IN. DEPTH OF CUT, AND VARIOUS FEEDS; COMPUTED FROM HEAT IN CHIPS

rake angle with a negative primary radial rake angle imposed at the cutting edge, was investigated. This arrangement proved to be more efficient under all conditions than a single radial-rake-angle cutter, either positive or negative.

Fig. 7 is a schematic diagram of a cutter tooth with a 12-deg negative primary radial rake angle and a positive secondary radial rake angle. Power consumption for this type of cutter is less than required for a 12-deg negative radial rake angle. The relationship of tool forces and radial rake angles is plotted in Fig. 8. This diagram was established previously for cutting speeds up to 800 fpm; this series of tests established the same relationship for speeds up to 1200 fpm.

While tests with positive radial-rake-angle cutters revealed complete fracture of the cutting edge after a few seconds of cutting at high speeds, they also showed that the same cutters, provided with a negative radial rake angle at the cutting edge, would resist wear better than cutters with full negative radial rake angles.

Points *A* and *B* in Fig. 8 show how tool forces can be reduced through the application of positive radial rake angles when the cutting edge is strengthened with a negative rake angle. Lower tool forces mean that each cutting tip is exposed to lower pressures during the cutting operation; this will result in a number of beneficial effects.

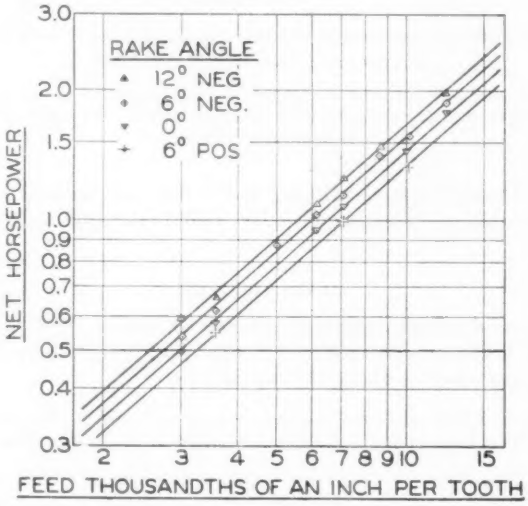


FIG. 4 COMPARISON OF NET HORSEPOWER REQUIREMENTS OF DIFFERENT RADIAL-RAKE-ANGLE CUTTERS AT CUTTING SPEED OF 960 FPM, 0.125-IN. DEPTH OF CUT, AND VARIOUS FEEDS; COMPUTED FROM HEAT IN CHIPS

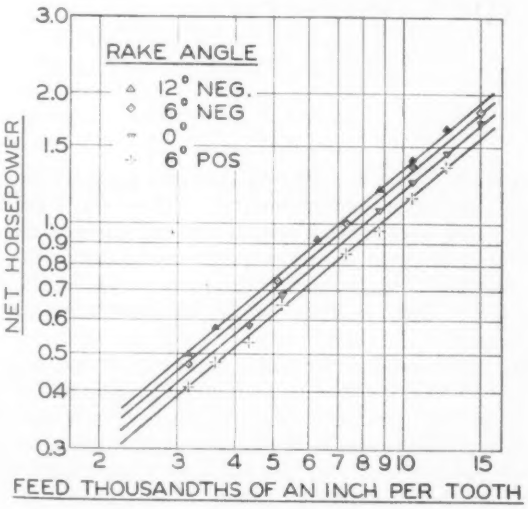
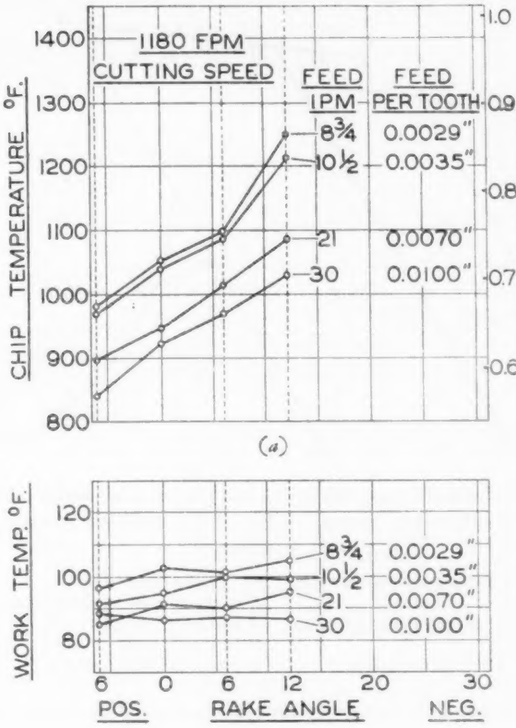


FIG. 5 COMPARISON OF NET HORSEPOWER REQUIREMENTS OF DIFFERENT RADIAL-RAKE-ANGLE CUTTERS AT CUTTING SPEED OF 785 FPM, 0.125-IN. DEPTH OF CUT, AND VARIOUS FEEDS; COMPUTED FROM HEAT IN CHIPS



(*b*)

FIG. 6 GRAPHS SHOWING TEMPERATURE OF CHIPS, NET HORSEPOWER REQUIREMENTS, AND SURFACE TEMPERATURE OF WORKPIECE

(*a*, Temperature of chips and horsepower per cubic inch per minute in relation to radial rake angles at 1180 fpm cutting speed and various feeds. Material cut is S.A.E. 1055, 1 in. diam, hot-rolled, and normalized. Depth of cut is 0.125 in. *b*, Surface temperature of workpiece, measured with thermocouple immediately after taking cuts plotted in upper graph. Room temperature is constant at 70 F.)

Conclusions previously reached[1] have been corroborated and extended so they apply to cutting speeds as high as 1200 fpm. The following points in particular have been substantiated in this investigation.

CONCLUSIONS

Negative radial rake angles were found to produce stronger cutting tips, the cutting edges of which are generally not as liable to fail from impact and shock when entering a workpiece of hard material as are the cutting edges formed by positive radial rake angles.

Power required at the cutting edge is higher for the negative radial-rake-angle cutter than for cutters with positive radial rake angles. This holds true for conventional cutting speeds as well as for higher cutting speeds up to 1180 fpm.

Cutters with negative radial rake angles will stand up longer at the higher speeds than positive radial-rake-angle cutters under identical conditions.

Wear and failure at high speeds on the cutting edge of a positive radial-rake-angle cutter will soon increase its power consumption above that of a cutter with negative radial rake angles.

Average temperature of the chips produced by ordinary feed does not approach the melting temperature of steel even at high speeds.

A cutter with a 15- or 30-deg positive secondary radial rake angle and provided at the cutting edge with a negative primary radial rake angle 1 to 2 times the width of feed per tooth was found to be a more effective cutter, since it combined the increased strength of the cutting edge afforded by negative radial

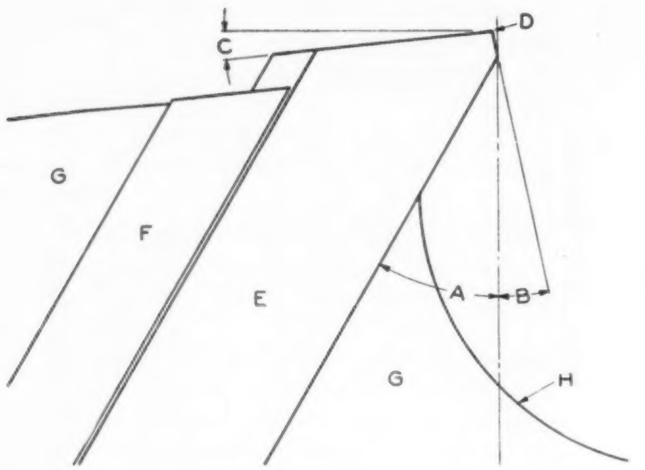


FIG. 7 SCHEMATIC DIAGRAM OF CUTTER TOOTH WITH 12-DEG NEGATIVE PRIMARY RADIAL RAKE AND POSITIVE SECONDARY RADIAL RAKE ANGLE

A positive secondary radial rake angle
B negative primary radial rake angle
C peripheral clearance angle
D cutting edge
E inserted solid carbide blade
F hardened wedge
G face mill body
H chip clearance surface

rake angles and the lower power requirement of the cutter with positive radial rake angles.

From the net horsepower at the cutter, as determined by the calorimeter, the tool forces were computed for the different rake angles with the formula

$$\text{hp} = \frac{F \times V}{33{,}000}$$

$$F = \frac{\text{hp} \times 33{,}000}{V}$$

where V = cutting speed, fpm.

This force, F, is the resultant force of several component forces, and it can be seen in Fig. 8 that it increases with the negative radial rake angle and decreases with the positive radial rake angle. It also shows how much the tool forces on a cutter with 12-deg negative primary radial rake are reduced by the application of a positive secondary radial rake angle of 15 or 30 deg.

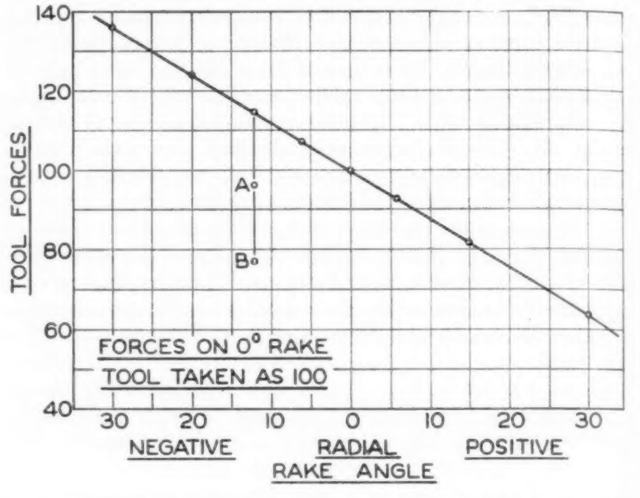


FIG. 8 EFFECT OF VARIOUS RADIAL RAKE ANGLES ON TOOL FORCES ACTING ON A FACE MILLING CUTTER

(Points *A* and *B* represent cutters which had a negative primary radial rake angle of 12 deg and a positive secondary radial rake angle of 15 and 30 deg, respectively.)

ACKNOWLEDGMENT

Grateful acknowledgment is made to Messrs. J. R. Roubik and J. P. Bunce of the authors' company for help in carrying out these tests and checking the manuscript.

NOTE: This is the first of three sections into which the continued tests[1] have been divided. Section 2 will appear in the next issue.

The Engineer's Status in the Community

(*Continued from page 402*)

Democracy and the Church have much in common, for they are both striving to enhance the dignity of the individual. Because of this it is to be hoped that the Church, without partisanship or fear of criticism, can find ways of more pointedly urging its members to discharge their civic responsibilities, thus implementing good character into good citizenship.

WE NEED YOUR HELP!

The committee, for the moment, has paused and is taking stock. War conditions have interfered seriously with the operation of our student branches and to some extent also with our sections. And yet our assignment is more important than ever and we must press forward with renewed vigor. That is one reason I have coveted this opportunity of sharing our ideas with you, in the hope that you may help us plot our course more effectively, and that we may receive your cordial and active co-operation.

IN CONCLUSION

I may seem to have strayed from the topic assigned me, "The Engineer's Status in the Community." There was a time, not so many years ago, when the engineer and scientist felt that their contributions to society were not recognized. We must admit, however, that in recent years the public has come to have a much better appreciation of our contributions to the common good.

On the other hand, it must also be admitted that engineers and scientists have concentrated so intensely upon their professional work that, like most other professional men, they have failed to appreciate adequately their responsibilities as citizens. The contributions that they can make by a more faithful performance of their civic duties can be of inestimable value to their various communities as well as to the nation as a whole. Moreover, their prestige and status in the community will be further enhanced to the extent to which they participate constructively in community and public affairs.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Gas-Turbine Locomotives

Comment by B. S. Cain[1]

The authors are to be congratulated on two of the most interesting and stimulating papers[2,3] which have been published on the subject of gas-turbine applications.

One of the features of the gas-turbine locomotive is the possibility of concentrating considerable power in a short, light, compact unit. This means a definite advantage over present-day Diesel locomotives in high-speed passenger service.

In Dr. Rettaliata's locomotive,[3] an axle load of 75,000 lb, or slightly less seems excessive for high-speed service. Mr. Sidler[2] has kept his axle loads down to the more satisfactory figure of 55,000 lb per axle, but at the expense of idle axles on the trucks. The writer's studies indicate that it is reasonable to consider a 4500-hp unit with all weight on six drivers, without exceeding 60,000 lb per axle. A design of this kind is a definite advance over present Diesel practice in the field of high-speed high-power units.

It is interesting that the gas-turbine power plants considered in both papers are of about 2500 hp net for traction. By using a larger power plant of about 4500 hp, the locomotive units can be made shorter, lighter, and simpler. The method of operating one or two power plants to improve efficiency at low loads is interesting, but there is certainly some question whether the complications in control or extra attention required from the operators would not, in practice, overcome the theoretical advantages of two plants.

Comment by W. S. H. Hamilton[4]

The following comments are made on Mr. Sidler's excellent paper[2] primarily from the standpoint of the operating characteristics of the railroad with which the writer is connected. These characteristics consist of an essentially level track with long runs at high speeds, and with terminals and principal intermediate stations in highly congested areas where space is at a premium.

In passenger service under such conditions, the ability of the locomotive to handle relatively heavy trains, say, 1000 to 1200 tons trailing (15 to 17 cars), at high speeds and to accelerate them up to full speed from slowdowns (say, from 50 to 80 mph) in the minimum time is very important if fast schedules are to be maintained. Also, it is more important to be able to make such accelerations rapidly than it is to be able to accelerate rapidly from rest (say, from 0 to 50 mph). On account of limitations in stations and terminals, the length of the locomotive is important, and it is desirable that this be in the order of 110 to 115 ft. In order to avoid the delays incident to turning locomotives at the ends of their runs, it is very desirable that they be double-ended.

While the use of a tender for fuel as proposed by Mr. Sidler for certain conditions of operation is not necessarily out of the question, at the same time it is desirable to avoid it if possible, on account of the extra switching required, which is of importance in congested terminals. It would seem as though it would be sufficient, for most conditions of operation, especially in the eastern part of the country, to provide fuel tanks on the locomotive itself sufficient for approximately 500 miles of operation.

In short, the more closely a self-propelled locomotive can be made to approach the characteristics of the modern electric locomotive in which 5000 to 6000 continuous tractive-effort horsepower can be provided with a length of less than 100 ft and without exceeding an axle loading of approximately 55,000 lb, the better adapted such a locomotive will be to the requirements of modern passenger service.

If the gas turbine could be rated at substantial overloads for short periods of time so that such overload ratings could be used during accelerations, with suitable restrictions as to their repetition imposed automatically or otherwise, it would enable this type of locomotive to approach more nearly the desirable characteristics of the modern electric locomotive. In such locomotives, the horsepower that can be developed is generally limited only by the adhesion, and large overload ratings for short time intervals are available. It is of course too much to expect that self-propelled locomotives can in the immediate future be made to equal modern electric locomotives in this respect, but this is a desirable goal to work toward, especially for passenger service.

The larger gas turbine of 4000 bhp as mentioned by Mr. Sidler[2] in the discussion of his paper, particularly if it could be rated as high as 6000 bhp during accelerations, would permit some of the foregoing objectives to be attained.

While the requirements of locomotives for main-line freight service are not so readily defined as for passenger service, it certainly should be desirable to attempt to build the entire locomotive in one unit, and probably a reduction in cost of the entire locomotive will be secured by increasing the brake-horsepower output of the individual gas-turbine units.

It would seem to be rather too early to talk about "standards" for such a new device as the gas turbine, and that such designation could well be deferred until more experience has been gained, particularly in operation under American railroad conditions.

In connection with the development of new gas turbines, it is suggested that all manufacturers bear in mind that in operation over a rolling profile, the load on the turbine will vary constantly and that some of the shop tests at any rate should be based on a cycle that will include operation at various loads, so that the effect of alternate heating and cooling may be determined. Sometimes such a requirement is more exacting on a machine than operation at a constant load and with more or less constant temperature conditions, even though greater, and lasting for considerable periods of time.

In Fig. 9 of the paper,[2] and also in that by Dr. Rettaliata,[3] the possibilities of improvement of the over-all efficiency of the locomotive by operation of one gas-turbine unit at loads up to the limit of its capacity and then cutting in the second unit, are discussed. While it might be entirely feasible to shut down one unit for a considerable period of time

[1] Assistant Engineer, Locomotive Division, General Electric Company, Erie, Pa. Mem. A.S.M.E.

[2] "Gas-Turbine Locomotives for Main-Line Service," by P. R. Sidler, Mechanical Engineering, vol. 66, 1944, pp. 689–696.

[3] "A Gas-Turbine Road Locomotive," by J. T. Rettaliata, Mechanical Engineering, vol. 66, 1944, pp. 697–704.

[4] Equipment Electrical Engineer, New York Central System, New York 17, N. Y.

on a long descending grade, where it was reasonably certain in advance that nowhere near the full horsepower output of a locomotive would be required for some time, it is not believed that the arrangement, proposed in Fig. 9, should be counted on for general railroad operation, particularly on railroads having a rolling profile. On such railroads, it will be necessary to make sudden demands on the gas-turbine units for power as the grade changes or accelerations are required, and this means that both turbines should be in operation and available for practically immediate power output. It would also seem as though the simplicity of having both turbines in operation practically all the time would outweigh whatever disadvantage there might be in not securing the maximum possible thermal efficiency.

It is desired to emphasize the importance of simplicity in any locomotive intended for American railroad service, and this seems to have been achieved in the gas-turbine unit proposed by Mr. Sidler. It is much more important and in fact essential to have a simple reliable unit of high availability than it is to attain the maximum possible thermal efficiency.

Referring to the tables of operating costs, Nos. 3 to 5, inclusive, the annual mileages given by Mr. Sidler look high for general train operation, particularly if such locomotives are used on all or substantially all the trains on a railroad, and it is believed they would be substantially reduced under such conditions.

The fuel-oil cost of 4.5 cents per gal for Diesel oil and 2.7 cents per gal for bunker C oil look rather low for oil purchased in the eastern part of the country, although it is possible that such costs might be realized in the western region nearer the oil fields.

No mention is made in this paper[2] of the possibilities of burning bituminous coal in gas-turbine locomotives. This would be an important development especially for service in those parts of the country where coal is plentiful and cheap. It is realized that it would introduce the problem of ash and its disposal, but the possible gains to be made would seem to warrant an attempt to solve this problem.

In this connection, it is noted that Dr. Rettaliata in his paper[3] mentioned the possibility of using colloidal fuel, and it would be interesting to know whether this has actually been tried and if so, how successful it has proved.

COMMENT BY J. S. NEWTON[5]

Little imagination is required to visualize the many potentialities of the gas turbine as a prime mover. Dr. Rettaliata[3] and Mr. Sidler[2] have given conservative, realistic treatment to this new type of power unit as it may be applied in the highly competitive, well-developed field of the road locomotive. It is believed that both authors have evaluated present possibilities fairly, particularly from the technical standpoint. Both have been wise in selecting an electric transmission, because it simplifies the design of the prime mover, and thereby reduces the element of time in proving that the device is practical.

A power unit of comparable output, speed, and size is discussed in each of the papers. The locomotives have been rated in much the same manner as Diesel-electric engines, that is, the total locomotive horsepower is the sum total of the power developed by the prime movers at their output shafts. We all recognize that the actual power at the rail or at the drawbar is substantially less, and the writer would like to make a plea that from the start we rate the gas turbine as we do the steam turbine in the transportation, central-station, marine, and industrial fields. The locomotive rating should be that horsepower which is available to do work at the rail, or at the drawbar, and at a reasonably high ambient temperature, 80 F or more. It is necessary to rate a gas turbine at a specific ambient temperature because of the large effect that the inlet temperature has on the maximum horsepower output; see Fig. 7 of Mr. Sidler's paper.[2] Though greater in effect, the inlet-air temperature of the gas turbine is comparable with the condenser - circulating - water temperature of a steam plant where a change in circulating-water temperature of 20 deg F affects the maximum output of the plant from 5 to 8 per cent. Steam-turbine ratings are based on vacuum at a specified circulating-water temperature.

Bunker C oil, more specifically No. 6 fuel oil is believed to be considered by both authors as a suitable fuel for a gas turbine. Also, an air preheater or regenerator is included with each design of prime mover. Knowing some of the operating practices necessary in keeping tubes clean in a boiler fired with No. 6 fuel oil, the writer would like to ask the authors if any provision has been made for removal of soot from the regenerator or if practical experience has shown that there is no appreciable accumulation of carbon? It would appear that the gas turbine will have to burn a low-grade fuel oil if it is to be a competitor of the Diesel.

There are several plots of thermal efficiency versus speed or power in each paper. The writer assumes that these values of efficiency are for the prime mover only, and that power for such auxiliaries as lube- and fuel-oil pumping, lube-oil cooling, fuel-oil heating, etc., have been excluded. In a gas-turbine unit, the writer has estimated that these losses plus the gear losses may approach 10 per cent of the gross power developed at full load, and at light loads they become an appreciably greater percentage of the gross power developed. In Fig. 8 of Mr. Sidler's paper,[2] the no-load fuel-oil consumption is less than one sixth of that at full load. This is assumed also, to exclude auxiliary losses.

Dr. Rettaliata goes into some detail to show the effect of different methods of control and operation. It is to be hoped that an exciter control can be designed which will automatically maintain the electric load on the prime mover as a function of speed-governor setting, making the use of regulating devices unnecessary. Reference is made to a control similar to that used on some Diesel-electric locomotives. This simple control will have to be modified for the gas turbine because its speed-power curve is not easily made linear. It is possible that it may be practical to operate a gas-turbine locomotive with one of two prime movers shut down. However, a similar economy advantage exists with the Diesel-electric locomotive, and it would be interesting to know whether this practice, except for emergencies, has been widely used with Diesel locomotives.

Dr. Rettaliata shows a lube-oil tank capacity of 1500 gal. Normally this quantity of lubricating oil would be expected to last for several years. In locomotive work it probably would be better practice to reduce the oil-tank capacity to that quantity pumped each minute or two and use the space thus gained for fuel or water. The smaller quantity of lubricating oil will not last as long, but the total lubricating-oil consumption should be little different over a period of years.

After a reasonable period of development both authors estimate the initial cost of the gas-turbine locomotive will be about 90 per cent of the cost of a Diesel-electric locomotive. The writer believes this to be optimistic, at least until a gas turbine for the application is tooled for mass production. Manufacturers of gas turbines will do well to be able to sell this type of prime mover at the same price as the Diesel.

The funds being expended each year on gas-turbine development, already in the millions, give evidence enough that there will be a future for this new type of prime mover. The gas-turbine locomotive appears promising as a competitor of the Diesel-electric locomotive today, and, when it is developed to burn coal, it can well be the standard road locomotive of the future.

[5] Assistant Manager of Engineering, Steam Division, Westinghouse Electric & Manufacturing Company, Philadelphia, Pa.

Comment by Ralph H. Miller[6]

The gas-turbine-locomotive design presented by Mr. Sidler is extremely interesting, but analysis of the performance curves leads to the inevitable conclusion that a practical design is not possible at gas temperatures lower than 1300 F.

In countries where turbine locomotives might be used, air temperatures will approach 100 F, over long periods of the year. Under these conditions the efficiency drops to 16 per cent and the shaft horsepower from 2500 to 2000. Deducting 200-hp auxiliary load and 50 hp for reduction-gear losses leaves only 1740 hp for traction purpose.

The compactness of the locomotive, shown in Fig. 3 of Mr. Sidler's paper,[2] is far superior to anything obtainable in present-day Diesel road locomotives in which low-power engines are used to produce high-power locomotives.

The apparent advantage is not so great when compared with a Diesel locomotive as it should and will be designed in the near future.

The 1300 to 1600-hp engines now used in Diesel road locomotives have been selected and designed on the basis of the false premise that the Diesel engine is subject to frequent unpredictable breakdowns and therefore must be serviced under way and at terminals. Hence parts must be small in dimensions and light in weight.

However, the proper approach is to so design and rate the engine that it will require no repairs except at regular scheduled shopping periods. Unless this can be accomplished the Diesel engine has no future as a road-locomotive prime mover.

Acceptance of this premise leads to the logical conclusion that the Diesel engine for high-power locomotives must be built with the largest bore and longest stroke which can be fitted in the cross section of the cab.

The cab length and axle arrangement, shown in Fig. 3 of the paper,[2] will then accommodate a Diesel engine of 2700 to 3000 hp, and this engine will be only 40 per cent longer than the 1300-hp sixteen-cylinder V-engine now in use.

Comment by E. J. W. Ragsdale[7]

The company with which the writer is associated does not build motive power, but is engaged in constructing railroad passenger cars. We cannot, however, be wholly indifferent to the locomotives that haul these cars. The writer agrees with Dr. Rettaliata[3] that the gas turbine has now reached the point where it is worthy of consideration as a prime mover in a locomotive. How long it will take to extend development to accepted railway practice cannot be predicted. In any event, the path should be made as easy as possible, and for that reason the writer applauds the selection of an electric transmission rather than complication of the issue by the introduction of fluid or mechanical drives. Personally, the writer has more confidence in a suitable development of the gas turbine than in the perfection of a mechanical or of a fluid drive for high horsepower. The electric transmission has already been developed.

The writer does not, however, subscribe to the ambitious application to a 4800-hp locomotive. The study shown by Dr. Rettaliata indicates axle loadings of almost 80,000 lb and three of these disposed within 16 ft. This will embarrass many bridge and track conditions.

The writer's idea would be to confine the effort to the 2200-hp unit such as Brown, Boveri has developed and to use multiple units where needed.

The passenger trains of the future are apt to be shorter ones with emphasis on frequency of service rather than on capacity.

Availability rather than over-all thermal efficiency should be emphasized to the extent of eliminating the heat interchanger in favor of simplicity and economy of space and weight. Fuel cost is actually a small percentage of operating expense. A tractive efficiency of 10 per cent would be admissible if availability could be improved.

The gas turbine is immensely attractive since we are not concerned with the cooling problem such as we have with the condensing steam turbine or the Diesel engine. We often forget what a wonderful institution is an ocean. Its temperature does not vary over 50 deg F, its density remains almost the same, and there is such a lot of it. On the other hand, when we have to resort to air, we have a possible 150-deg F fluctuation in temperature, a 30-deg variation in density, and air currents which are not susceptible to control. Air is not a desirable medium.

The writer is gratified to have available the data in Dr. Rettaliata's paper and to know that the gas-turbine development is being extended into the railway field, in which the writer is vitally interested.

Comment by J. Kenneth Salisbury[8]

Brown, Boveri & Co., Ltd., and particularly Mr. Sidler, are to be complimented for their willingness to make available to the avid engineering public their thoughts and plans on the gas turbine and its applications. Mr. Sidler's publications over a considerable period of time have constituted the backbone of gas-turbine literature. A certain amount of courage is required to present plans for a locomotive such as the one discussed in this paper[2] when it is realized that, due to the rapid development of the gas-turbine art in a war period, many of the details of design may be changed by the time such a locomotive is built. On the other hand, the writer is certain that no intelligent engineer, realizing the situation, can possibly be critical of changing plans and will regard the current design only as a presentation of the status now rather than a promise of future construction.

It goes without saying that the gas-turbine power plant is in reality a competitor of the Diesel engine in locomotive service. The gas turbine in current thinking is considered to have greater simplicity and lower maintenance than the Diesel but these are partially offset by the higher fuel cost, even when a fuel costing approximately 60 per cent of Diesel fuel is used. These facts are reflected in Mr. Sidler's Tables 3, 4, and 5.[2]

While our studies of the gas turbine have led us to believe that the price of gas-turbine units will be less than that of comparable Diesel-electric units, the relative depreciation of the two types in railroad service cannot be known at the present time because of lack of experience both with the Diesel and with the gas turbine in locomotives. The earliest road-type Diesel-electric locomotive in passenger service is approximately 10 years old, and in freight service approximately one half of this. The oldest and the only gas-turbine locomotive is the Brown, Boveri 2200-hp unit which has been in operation approximately 2 to 3 years.

The charges for depreciation and maintenance of power plants in railroad service are quite completely interwoven since it is common practice for all railroads to replace worn parts in a program of preventive maintenance, thus prolonging the life of all types. In the absence of facts, our present thought on the maintenance of the gas-turbine locomotive power unit is that the maintenance relative to Diesel maintenance will bear about the same ratio as Mr. Sidler has shown, or possibly a little higher.

It should be emphasized, however, that the entire advantage in annual expense, shown in Table 5 of the paper,[2] for the 7500-hp freight locomotive disappears if equal depreciation rate (5 per cent) is used for both units.

[6] Chief Engineer, Worthington Pump and Machinery Corporation, Buffalo, N. Y. Mem. A.S.M.E.

[7] Chief Engineer, Railway Division, Edward G. Budd Manufacturing Company, Philadelphia, Pa.

[8] Turbine Engineer, General Electric Company, Schenectady, N. Y. Mem. A.S.M.E.

Each type of motive power has a field in which it can make the most of its advantages. General comparisons must therefore be made and used with care, since a change in assumed conditions may unfairly favor one particular type.

However, one general study, recently made by the writer and his associates, indicated that under particular conditions which involve locomotive operation of 125,000 to 150,000 miles per year in freight service, the relative operating costs of the power plant, exclusive of maintenance, were estimated to be practically identical on the basis of a bunker-C-burning gas-turbine plant.

This study indicated among other things, that even with a higher fuel cost than its competitors, the gas-turbine plant may show lower total operating costs, providing the maintenance is lower. It was also noted in this study that the fuel cost of a hypothetical coal-burning gas-turbine locomotive would be so low that greater efficiency would not be as important as reduction of first cost and maintenance expense. For the oil-burning gas turbine, however, efficiency is still a major factor.

We thoroughly agree with Mr. Sidler that increase in initial temperature is of vital importance to the gas-turbine locomotive. The rapid progress in metallurgy throws some shadow of doubt on the proposition that a gas-turbine locomotive put in service in the near future at temperatures of 1100 to 1200 F will remain modern for the life of the locomotive.

We would like, therefore, to ask Mr. Sidler whether any provision has been made for rebuilding this locomotive to accommodate higher temperatures when the metals for these temperatures become available, and whether if this is done the increased power which he mentions (7600 hp in a single cab) is contemplated. Such rebuilding for higher powers would, of course, have to include the electrical equipment. It would be an entirely fair alternative, on the other hand, to accept the gain in fuel economy without increase of the rating.

All designers of gas turbines are necessarily on their mettle to prove the advantage of these units over the Diesel, which is accepted as the prime mover having the higher thermal efficiency. The Diesel field is tending toward the installation of more power in one cab. Units of 4000 to 6000 hp per cab are currently projected, according to the writer's information. High supercharging of the Diesel engine is one important development from which little has been heard to date but which has possibilities, especially in locomotives where high "output density" is of prime importance. Others have proposed the use of a free-piston gas generator supplying hot gases to a gas turbine which then produces all of the net power. Such an arrangement is estimated to have a rather high thermal efficiency and must be reckoned with in considering the future of the self-powered locomotive.

It is believed that continued high efficiency is dependent to a considerable extent on supplying clean air to the compressor and preventing formation of deposits upon the gas-turbine blading. In going across the Arizona desert, for example, particles of sand might be picked up, which could be detrimental to the blading of the machines. Estimates indicate that a 5000-hp unit of this design will require approximately 100,000 cfm of air—a very considerable quantity; and we would like to inquire as to what provisions are made in this locomotive for cleaning this air. With respect to turbine-blading deposits, has any previous experience indicated accumulation of a hard glaze consisting of metallic oxides when bunker C fuel is burned?

Mr. Sidler has stated that sudden heavy overloads will not stall the gas turbine as in the case of the Diesel engine. Is it not so that, if the unit is running at reduced speed and sudden heavy overloads occur, such stalling may result? Since the compressor cannot accelerate instantaneously, reduced air flow limits the fuel quantity which can be supplied to the unit without attaining excessive temperatures. This limitation in fuel flow will yield an output which may be less than the applied load and may result in further slowing down of the unit which would aggravate the situation. It appears that since, in most cases, heavy load demands in railroad service may be anticipated, it would be desirable, whenever there is any possibility of such heavy loads occurring, to run the prime mover at, or near, full rated speed. Under this condition of part-load full speed, the fuel economy of the set will be considerably poorer than when the latter is running at its best economy speed.

Since pressure drop at any point in the gas-turbine system has an adverse effect on both the capacity and the thermal efficiency of a gas-turbine power plant, it is important that this be kept to a minimum. The regenerator must be appropriately designed for low pressure drop in order more fully to realize the advantage accruing from its use. In this connection will Mr. Sidler please give further information as to the design of this regenerator, the type of surface, the gain in fuel economy expected, and the provisions which are made for cleaning fouled surfaces?

COMMENT BY C. RICHARD SODERBERG[9]

These two excellent papers[2,3] indicate that we have traveled quite a distance in the relatively short time that this subject has been active. It is appropriate to enlarge upon locomotive applications, because the gas turbine has particular promise in this field.

While the performance figures presented in these papers are fair and reasonable, the writer does not believe that they are outstanding enough in themselves to make an undisputed case for the gas turbine. The real incentive will appear with potential improvements in the future. With this in mind, the use of a regenerator is commended, even though the present level of performance might be obtained without this device by more efficient rotating machinery and higher temperatures. To take advantage of the potentialities of the gas turbine in the future, however, the regenerator is indispensible, and design and operating experiences accumulated on the regenerator will pay dividends in the future.

The writer should like to ask both authors what effectiveness has been assumed or, if they prefer, the number of square feet per useful horsepower?

With regard to the lubricating-oil consumption; has Mr. Sidler's company actually obtained measured values, or is the fuel-oil consumption indicated an expected figure?

COMMENT BY G. GEOFFREY SMITH[10]

Fortunately, the gas turbine is not "fussy" about what fuel it uses, and it is a fact, of course, the cost being low and weight not important in a locomotive, that an entirely different problem exists from the one that the aircraft engineer has to face.

Obviously, in the case of aircraft, weight is an extremely important factor, so that cost of fuel is not the only consideration in studying the appeal of the turbine.

Another entirely different point is this: The effect of cold air, which has been stressed as beneficial, is automatically taken care of by the aircraft itself. In other words, the higher you ascend, the greater the over-all efficiency because the air temperature becomes cooler and in every way is beneficial, but particularly to compressor efficiency.

The locomotive axial-flow compressor designs are quite impressive. It would seem to be certain that in the very small turbines, and, after all, they would be relatively small on an aircraft, we would have to come eventually to that particular type. We shall never attain high

[9] Professor, Massachusetts Institute of Technology, Cambridge, Mass. Mem. A.S. M.E.

[10] Editor of *Flight*, London, Eng.

thermal efficiency without axial-flow compressors.

The 20 per cent figure quoted for thermal efficiency of the locomotive-type turbine was a disappointment, considering the known efficiency of the Diesel. Possibly there is an explanation for this low value.

The United States and Switzerland are to be congratulated very highly for the wonderful work they are doing in the general development of turbines of all kinds. The whole world is going to benefit by this work later. If we could attain the 1380 F that Mr. Sidler quoted with 28 per cent efficiency, there is no doubt about it that the old jibe that "the turbine is a hot-air engine" will have to be forgotten forever.

Undoubtedly, as everybody now realizes, we are in the era of rotative power. The reciprocating engine, the writer thinks, is under suspicion. Further than that, it has a real competitor for the first time in 40 years.

With turbines there are no gears and there is no rubbing contact. That was not brought out, though it is an obvious fact. Therefore, half the normal lubrication problems or possibly three fourths of them disappear.

Who will eventually make the turbines for aircraft? Will our accepted aircraft-engine manufacturers with their fund of knowledge of installation produce them, or will the experienced turbine manufacturers widen their scope to include aircraft units? There is fair competition for them all, but who will specialize because undoubtedly many future aircraft will have turbine power units. Right now we want large power units, for the big civil aircraft types that are being projected. We do not have them. It takes a long time to develop new piston engines, say, 4 years. To develop a turbine of the power required, say, 5000 hp, would take about one quarter of that time.

Referring to the contrast between Diesels and turbines, it is rather deplorable that the gas turbine threatens to short-circuit the Diesel in so far as aircraft are concerned. We were all waiting for Diesels, but the war upset essential development work. But now that the gas turbine is becoming available, development and research on aircraft Diesels are likely to be lacking.

Personally, the writer thinks the order of application of turbines will be (1) aircraft, (2) locomotive, (3) marine work, (4) stationary work, and (5) road transport, that is, the heavier types of road vehicles.

In England, we have a research association making a complete examination of the turbine for marine work. We are already actively engaged on turbines for aircraft work, and in other spheres including locomotives. It is good to think that, in close association and mutual collaboration with turbine engineers in America, we are busily preparing for this new era in power generation. We wait upon the metallurgists.

Comment by Sidney Withington[11]

These papers[2,3] are most interesting and timely, and the Society is to be congratulated on having them on its current program. The turbine has obvious advantages over reciprocating devices, especially where high pressures are involved, as in steam or Diesel engines. The gas turbine is now at a state of development comparable in some ways to the steam turbine of about 1900, although the designers of the gas turbine have many advantages in utilizing metallurgical developments which their predecessors did not have. It is not impossible that relatively slight experience in the not distant future will result in a sudden development and general utilization comparable with the history of the steam turbine.

Dr. Rettaliata's paper[3] indicates a 1500-gal lubricating-oil tank capacity. This seems unnecessarily liberal in view of the relatively slight lubricant requirements. Undoubtedly attention has been given to this minor de sign factor.

The use of pulverized fuel and colloidal fuel is of great interest, and it is entirely possible that metallurgical advances may permit development of material of satisfactory resistance to ash erosion. The use of coal for at least part of the fuel would be desirable. Metallurgical advances will also undoubtedly make possible higher temperatures with greatly increased efficiency. The relatively lower efficiency and the limited load zone at which maximum efficiency is obtained present some handicap as compared with Diesel operation, even though lower fuel prices offset these factors.

Mr. Sidler's paper[2] indicates a change in the efficiency and capacity with ambient temperatures affecting air intake. Presumably these characteristics are also affected by barometric changes. Some word would be of interest in this connection, especially where the locomotives are to be used in relatively high altitudes. A discussion of compressor control to take care of changes in these factors would be of interest.

The over-all lengths of 90 ft presented in the locomotive design by the Allis-Chalmers Company, and of 98 ft indicated in the Brown, Boveri locomotive, are not unduly troublesome, but the three-cab length suggested by Mr. Sidler of 198 ft may be a problem in stub-end passenger terminal tracks where the passenger platforms are limited, and the locomotive entering the station would occupy a considerable portion of the unloading platform.

The utilization of waste heat for train heating is so attractive that it should be seriously considered in spite of complications. The train-heating boiler on electric and Diesel locomotives is one of the serious expense problems presented by these types of equipment.

The axle weight of 75,000 lb suggested by Dr. Rettaliata is high even with 52-in. drivers, and a number of railroad operators will raise their eyebrows at such axle loads.

The use of single-end cabs will involve turntables or wyes at the engine terminal which may be a distinct disadvantage in some cases, especially where the terminal is crowded. Double-end operation is one of the advantages of Diesel and electric locomotives.

The necessity of dropping load suggested by Dr. Rettaliata to permit turbine acceleration, or changes in connections, may not be desirable in some instances, and it is probable that operating experience may make this unnecessary.

Some discussion would be of interest in connection with overloading the turbine, and advice as to just what this would mean. Would the turbine stall on overloads or does the electric drive give protection in this respect?

It is vitally important when defining horsepower and efficiencies, that a standard basis be adopted. Both authors apparently use various horsepowers in their discussions, and a single figure should be arrived at in rating any type of locomotive. A logical definition would be the drawbar or over-all horsepower of the locomotive, which would permit accurate and intelligent comparison with other types of locomotives.

In Fig. 8 of Dr. Rettaliata's paper,[3] a constant horsepower of 4000 at the rail is given from 60 to 100 mph. Would this be a fact?

An interesting question arises in connection with oil fuel for gas turbines or Diesel locomotives, in connection with the future of petroleum production and processing. It seems at the moment that future costs are quite uncertain and should be carefully analyzed before a general program of motive power is planned. It seems probable that after the war it will be found necessary to conserve the petroleum reserves in this part of the world, which will mean importation of all crude oil from abroad. In addition to this, the increased demand for petroleum products for synthetic rubber, and for air and highway trans-

[11] Electrical Engineer, New York, New Haven, & Hartford Railroad, New Haven, Conn. Mem. A.S.M.E.

portation, the Army and Navy, merchant marine, and domestic heat, will mean increased costs; also the catalytic- and molecular-cracking processing will make distillates, which are now by-products to some extent, available for the higher priced products, which will automatically increase the cost of Diesel and heavier oils. These considerations may upset the balance in any present analysis of costs between Diesel engines and gas turbines, and steam or electric locomotives.

Mr. Sidler's tabulated analysis is interesting but should, it is thought, to be complete, include the unit prices per gallon or Btu of gas-turbine and Diesel fuel. It does not seem logical to give the gas-turbine locomotive added life compared with the Diesel, as the whole situation is so uncertain at the present time. In figuring depreciation, it would be logical to set up the annual charges on an annuity basis, rather than as indicated. A 20-year life would thus mean about 3 per cent, instead of 5 per cent.

It is to be hoped that it will soon be practicable to build trial gas-turbine locomotives in order to establish definite data as to their operating characteristics.

CLOSURE BY P. R. SIDLER[12]

Colonel Ragsdale's comment that he would like to see trials started with a 2200-hp gas-turbine locomotive are of interest. Such a suggestion is appreciated, particularly if the emphasis is on starting the trials now.

Whether the rating be 2200 hp exactly, as on the locomotive in Switzerland, or 2500 hp, as we can now get with the same frame size, incorporating some of the experience, is not too important. It is believed, however, that the time is material, and that it is ripe for starting.

Among Mr. Newton's comment is noted his question as to the removal of soot from burning bunker C oil. While we have used that expression in describing the fuel used in the gas turbines running in Switzerland and other parts of Europe, the liquid that has been available in Switzerland in these last few years hardly deserves the name of bunker C fuel. Hence there is great justification for a question on soot deposits. Unfortunately, no information is available as to what steps had to be taken, and it is believed that even if one knew something about frequency of soot removal, it would not be entirely conclusive because it is expected that after the war, it will be possible to get oil again, that is, at least bunker C.

[12] Resident Engineer, Brown, Boveri & Co., Ltd., New York, N. Y. Mem. A.S.M.E.

The author regrets that he does not have even general information on what has happened in regard to soot. While probably it has been a problem, nevertheless, these units still run. Evidently means have been found to remedy that situation if it has developed, as is more than likely.

Mr. Salisbury has asked a number of questions, the answers to which will also explain some of the questions asked by other discussers.

In regard to depreciation, the author agrees with him that it is difficult to say whether a Diesel locomotive will stand up for 15 years or a gas-turbine locomotive will stand up for 15 or 20 years. It is true that we cannot say so on the basis of facts, since certainly the power gas turbine, whether in a locomotive or in any other kind of application, has not been in continuous operation for anywhere near 15 years.

We do, however, have quite some experience in this line which allows a fair judgment of this situation. Our Velox boiler included units of this type as early as 1932. True, the temperatures and the pressures are somewhat lower. The nature of the fuel is the same, the effects from products of combustion on the blading are the same, so that the behavior of those units is of some interest and permits conclusions on what other gas turbines, more modern and larger gas turbines, can be expected to do.

We have Velox units which have run by now some 70,000 hr, and they still have their original blading and all the other original parts that might be questioned in regard to life, thus we feel that it is a conservative estimate that a gas turbine can have a life of 20 years.

That, however, does not take into account technological development. It is quite possible that a gas turbine built today may be obsolete in less than 20 years. In fact, it probably will be.

In regard to locomotive units built today for 1112 F, Mr. Salisbury asked whether it would be proposed to rebuild them later on when metals to withstand higher temperatures become available. We do not suggest that many locomotives should now be built for 1112 F. We believe that in a relatively short time, say, in 2 years after the war, metals will be available which will permit going substantially higher than 1100 F.

It is the author's idea, however, and of the company he represents, that the time is ripe to start with a locomotive gas turbine now designed conservatively for 1112 F, because we know that with this temperature it will stand up. With such a unit, a number of questions in the application to a locomotive and in operating it on American railroads can be clarified, and thereby experience gained which will not be altered by later increases in the temperature.

Thus we would save all the time which may yet have to elapse before we get into higher temperatures and could eliminate whatever "bugs" there may be in the application, in the controls, or in some methods of operation. These will be exactly the same whether the turbine runs at 1100 or at 1300 F.

Basically, it would not be desirable to build large numbers of locomotives at this time, but it should be emphasized that it is time to construct one gas-turbine locomotive soon.

Mr. Salisbury also brought up the matter of air cleaning. It is true that these units do require large volumes of air. We have no records on some of the gas turbines running in other European countries for reasons of censorship and others, so on that point the author can speak only about the units that run in Switzerland, the stationary unit in Neuchatel, and the locomotive unit.

This is the first time that the proverbial cleanliness of the Swiss mountain air has been questioned.

There has been no trouble in regard to deposits in the compressors of these gas turbines, and no means have so far been necessary for cleaning the air. In other parts of the world—we have been proposing the installation of gas turbines in desert country—that may be a major question to be solved. Air filters are contemplated in the design discussed in the paper.[2]

As regards soot, as already mentioned in reply to Mr. Newton's remarks, no information is available. It is possible that data may come through soon and an endeavor will be made to bring it to the attention of those interested.

It is true that taking overloads means going to higher temperatures and, naturally, we cannot exceed the safe limits. It must, however, be realized that when we say 1112 F is safe, this applies to continuous operation. It is entirely possible for this metal to take short-time peaks much higher than that, say, 1200 F, or, 1250 F, without any ill effects. Operation at such temperatures is permissible during about 10 per cent of the total operating time.

As to the heat exchanger, not much detail is available. In design, it is a tubular apparatus. Its surface on the 2500-hp locomotive unit is about 3200 sq ft.

Professor Soderberg asked whether the lubricating-oil consumption was expected performance or based on experience. Actually, it is based on the behavior of the gas turbines in Velox boilers, of which there are nearly a hundred, some of which have run for 10 to 12 years, more or less steadily; also

on the experience gained with some of the Houdry units, and as far as it was possible to ascertain on the six gas turbines that have been operating during the last few years.

G. Geoffrey Smith expressed disappointment over the maximum thermal efficiency of 20 per cent. Brown, Boveri & Company is well aware of the improved efficiencies to be obtained when operating at higher turbine-inlet temperatures. It questions, however, the claims advanced elsewhere about long-time or continuous operation with temperatures of 1500 F or even higher. As already indicated, we believe that experimental gas-turbine units for locomotives or other applications should be installed in this country without delay, and that all the experience gained in such plants will be applicable and useful when we are ready to go to higher temperatures some years from now.

In the meantime, of course, development work and research along these lines continue. At this moment, a new gas-turbine power unit for locomotive use is under construction at the Brown, Boveri shops. Its rating is 4000 hp at 1112 F, but at about 1300 F, it would develop 6000 hp. It could also give 4000 hp at about 25 per cent thermal efficiency. This unit is scheduled for completion in the spring of 1945 and will then be subjected to extensive trials on the test floor and on wheels.

In reference to Mr. Ralph Miller's comments, it should be emphasized that 2500 hp is by no means the limit for a gas-turbine power unit which will still fit into a locomotive frame. It has just been mentioned that a 4000-hp unit for 1112 F gas-inlet temperature and for locomotive use is under construction at our Swiss factory.

This will explain that it is not necessary to use the available frame size, producing 2500 hp with an air-inlet temperature of 68 F, for a locomotive which will run in an air temperature of 100 F during long periods.

There is no basic difficulty in designing a power unit which will produce 2500 hp net output with an ambient air temperature of 100 F and which, with a somewhat larger heat exchanger, will still have an efficiency at least near 20 per cent.

The total load requirements for all the auxiliaries on the 2500-hp locomotive have been carefully analyzed, with the result that the 65-kw auxiliary generator, built on the same shaft, was found to be ample for all these requirements. This is less than one half of the 200 hp assumed in Mr. Miller's discussion.

As a whole, the author cannot agree that it is necessary to wait until we can design a gas-turbine locomotive unit for 1300 F gas inlet temperature. On the contrary, it would be highly desirable to put such a unit, built for the present safe limit of 1112 F, on the rails at an early date, so that experience in actual main-line railroad service can be accumulated.

The author is convinced that such trial operation will fully justify the confidence which we now place in the gas turbine.

B. S. Cain correctly points out that one gas turbine of larger unit capacity would have several advantages over two units each of approximately half this size, installed in one locomotive.

In response to G. Geoffrey Smith's comments, it has already been mentioned that a gas turbine for locomotive use of 4000 hp at 1112 F is under construction in the Brown, Boveri shops and should be ready for tests in a few months from now. This shows that we do not propose to stand still with a 2500-hp power unit.

The main reason for recommending this smaller unit size now is that it is immediately available for installation and that its performance is well known and can be guaranteed. Later on when the 4000-hp unit has been tried out, also probably at temperatures higher than 1112 F, and with correspondingly higher rating, it will be our recommendation to use this larger unit size whenever the requirements call for this capacity. Meanwhile, the available 2500-hp unit could have accumulated experience in actual locomotive operation, and the results obtained would be equally applicable and useful for larger unit sizes to be installed at a later date.

W. S. H. Hamilton's detailed discussion is greatly appreciated and his suggestions will be studied with all the attention they deserve. Some of his points have already been commented upon in response to other discussions. Short-time overloads, particularly for accelerations up to full speed after slowdowns are entirely feasible with the present gas turbine, provided that the total time of such overloads, i.e., operation at 1200 F or slightly higher, is limited to about 10 per cent of the entire running time. The 5000-hp locomotive in Fig. 2 of the paper,[2] could thus develop at least 6000 hp during about 6 min in every hour or during about 1 hr in a nonstop run of 10 hr.

The necessary fuel capacity for a run of approximately 500 to 600 miles can readily be built into the locomotive with an over-all length of less than 100 ft and without resorting to a tender.

The fuel costs used for Tables 3 to 5 of the paper[2] are somewhat arbitrary, and it was mentioned that they may vary, even quite considerably, from one location to another. It is believed, however, that the relative cost of Diesel oil in comparison to bunker C oil, i.e., the ratio of 5:3, is more or less constant throughout the country and over a period of years. On this basis, the influence of fuel costs on the total operating expenses of the two locomotive types remains the same even if the absolute prices for the two fuels were quite different from the assumption made.

The possibilities of using solid fuels in pulverized or colloidal form have been under systematic investigation for several years. The problem of ash erosion particularly on the gas-turbine blading is considerable and no commercially acceptable solution has as yet been found. While the results so far achieved are decidedly promising, it will probably take a few more years of research to obtain practical designs.

We are here faced with a situation somewhat similar to that with higher operating temperatures or larger unit sizes. Rather than await solutions for all these problems and thus postpone work on a trial gas-turbine locomotive for several years, it would appear desirable to build an oil-burning locomotive with conservative specifications now and to apply the experience so obtained to coal-burning gas-turbine locomotives later on when this fuel problem has been worked out.

Referring to Mr. Withington's comments, it is agreed that a lubricating-oil capacity of 1500 gal is unnecessarily large and that an axle load of 75,000 lb is excessive (both suggested in Dr. Retaliata's paper[3]).

The thermal efficiency of 20 per cent is practical now and can be guaranteed. All expectations of high efficiency with higher turbine-inlet temperature must be tempered by the realization that metal alloys able to withstand such temperature continuously are not yet available. Short-time performance of a few hundred hours at such temperature levels does not necessarily result in equally satisfactory behavior when we have to consider operating periods of 20,000 hr or more.

It is, however, important in locomotive work that the best efficiency be obtained at 60 to 75 per cent load rather than at full load.

Diminishing air pressure at higher altitude will reduce the net output of the gas-turbine set. Higher altitudes are, however, normally associated with lower air temperatures, which would increase the net output, and the two influences practically balance themselves, at least in the range of altitudes encountered in adhesion railroad service.

Sudden heavy overloads on the gas turbine will not stall it but will result in a momentary speed reduction until the fuel governor and the excitation control on the generator have had time to adjust themselves.

The horsepower ratings of 2500 hp and multiples thereof are referred to the generator coupling. At the rail, the over-all efficiency of the electrical transmission must be considered, and will result in about 2150 hp. It is readily agreed that a standard method of rating for any type of locomotive would be very desirable.

Mr. Withington's concluding remark meets with our wholehearted approval. It is indeed hoped that means may be found to build in the very near future at least one gas-turbine locomotive for trials on an American railroad. Brown, Boveri & Co. is ready to contribute its full share to such an experimental and very promising venture.

Closure by J. T. Rettaliata[13]

Colonel Ragsdale's concurrence in the selection of the electrical type of transmission during the introductory period of the gas-turbine locomotive is acknowledged; but it is believed that after the merits of the gas turbine itself have been established, consideration should also be given to the mechanical transmission, as the latter type has certain desirable characteristics which would appear to justify its adoption for locomotive practice.

Much thought was given to the capacity of the locomotive described in the paper. Naturally, different railroads have varying preferences regarding locomotive sizes, but from the information at hand it was concluded that a design having maximum feasible horsepower per cab would be the closest approach to universal requirements. Hence a capacity of 4800 hp was adopted. It is appreciated, however, that, as mentioned by Colonel Ragsdale and Messrs. Withington and Cain, the proposed design has high axle loadings; but by the use of lightweight alloys, as indicated in the paper, and reduction in such items as lubricating-oil tank capacity, it is expected that axle loadings comparable with present practice will be obtainable.

Colonel Ragsdale's desire for simplicity and reliability is heartily endorsed but the author does not believe that these items would be affected adversely by retaining the heat exchanger. The latter is a stationary piece of low-stress equipment with anticipated minimum maintenance. With proper combustion the cleaning problem should not be acute. The increased thermal efficiency with the heat exchanger in the cycle would reduce the amount of fuel required for a given run, thereby offsetting the weight of the regenerator as well as lowering operating costs.

Referring to the comment of Messrs. Withington and Newton, regarding the rating of the power units, the coupling horsepower was adopted in conformity with present Diesel-locomotive practice so that comparisons could be readily made. It is appreciated, however, that a rating referred to the rail would be more significant since it would embrace any differences in types of transmissions and auxiliaries. The rail horsepower for the proposed gas-turbine locomotive is shown in Fig. 8, curve *B*, of the paper.[3] All capacity figures quoted in the paper are based on a temperature of 80 F for the compressor intake air.

The fuel oil used in the paper is somewhat lighter than a bunker C grade but, assuming its cost to be 4 cents per gal, the locomotive described in the paper still compares favorably on a fuel-cost basis with other types of locomotives. It is not contemplated that the matter of soot deposition in the regenerator will approach the magnitude of that of boilers fired with No. 6 fuel oil, as mentioned by Mr. Newton, since the gas-turbine cycle operates on a much larger excess-air ratio than is found in boiler practice. Actual tests on gas-turbine units show an exceptionally clear stack.

In reply to Mr. Newton's comment, concerning thermal efficiency, as indicated, Fig. 5 shows the thermal efficiency at the coupling, while Fig. 11 gives it at the rail including all auxiliaries. An ambient temperature of 80 F has been used in the thermal-efficiency calculations.

The type of control to be used, in so far as the operator is concerned, will be similar to present practice, with simplicity being given prime consideration. The author concurs with Messrs. Withington and Newton that there may be merit in adopting a smaller lubricating-oil-tank capacity. Such a modification would assist in the reduction of axle loadings without affecting length of run. The expected locomotive cost mentioned in the paper is on the basis that some amount of quantity production will be involved.

Messrs. Withington and Hamilton rightly emphasize the desirability of using coal as a fuel for gas-turbine locomotives. Experiments with pulverized coal show that it can be burned satisfactorily under the conditions existing in a gas-turbine cycle but that the ash causes excessive erosion of metallic blades when it is not removed prior to entry into the turbine. Ceramic materials, however, under similar tests do not indicate any erosion tendencies. Based on test results to date, if pulverized coal is to be used with metallic blades, apparently some form of ash separator will be necessary.

Referring to Mr. Withington's statement concerning the effect of altitude on the output of a gas-turbine locomotive, the power will decrease approximately 3 per cent for each 1000 ft increase in elevation above sea level. Fortunately, lower temperatures usually exist at the higher altitudes which would tend to offset this effect. Several methods could be employed to remedy the power deficiency if it is of limited duration, such as injecting water into the combustion chamber or increasing the turbine-inlet temperature.

Regarding the matter of overloading mentioned by Mr. Withington, assuming there is a demand for more power, the throttle is advanced in fulfillment with the result that more fuel is introduced into the combustion chamber and the rotative speed of the prime mover is subsequently increased. This procedure is repeated when necessary until maximum load exists on the unit. Due to the regulatory action of the speed governor and the thermostatic control of the turbine-inlet temperature, the maximum prescribed output cannot be exceeded in normal operation. If additional power were required, such as when traversing a grade, the train will slow down until a power balance exists. Since this would result in increased current in the traction motors, it would be necessary below certain train speeds to limit the duration of the operating period. Thus when loads beyond the maximum are demanded the train speed will be reduced but the turbines will not stall.

The available power developed at the coupling of the gas-turbine prime mover is independent of train speed and is therefore constant as shown by curve *E* in Fig. 8 of the paper.[3] As indicated by the curve the full 4800 hp of the power plant is usable at all times. Consequently, the rail horsepower will vary directly with the transmission efficiency, corrected for auxiliary-power requirements. Accordingly, in reply to Mr. Withington's question, the rail horsepower from 60 to 100 mph is constant at 4000 hp since the corrected transmission efficiency in this range remains at a value of 83.5 per cent.

Mr. Cain advocates the use of larger power plants as a means of achieving a lighter-weight design. The author does not concur with this reasoning, for, assuming geometrical similarity, if a single gas-turbine prime mover of 4800 hp had been used, it would have been 41 per cent greater both in diameter and in weight per unit output. This is on the basis that the larger and smaller units would each have the same number of stages in the turbines and compressors, and that the stresses are identical in corresponding regions of each machine.

[13] Manager, Research and Gas Turbine Development Division, Steam Turbine Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Mem. A.S.M.E.

In the interest of reliability, which is considered of prime importance for railroad practice, the gas-turbine power plants described in the paper[3] are of conservative design in that the blade and rotor stresses are very moderate. Lighter weight could have been achieved if higher stresses had been adopted but such a procedure was deemed inadvisable. Furthermore, multiple units appear to be advantageous as far as servicing is concerned, and also in the event of breakdown of an engine while under way.

The author agrees with Professor Soderberg regarding the desirability of employing a regenerator as a means of increasing thermal efficiency. The type described in the paper has an effectiveness of 50 per cent and a surface of 1.4 sq ft per useful horsepower output of the gas-turbine power plant.

In connection with Mr. Smith's comment concerning thermal efficiency, the author is of the opinion that the figure of 20 per cent, referred to the power-plant coupling as quoted in the paper, is adequate at this stage of development since it results in essentially competitive fuel costs. Higher efficiencies could have been provided but only at the expense of modified designs embodying increased temperatures and weight. In the interest of continuity of operation, it was considered inadvisable to incorporate such features until the proposed design of locomotive had established itself.

Regarding Mr. Hamilton's query concerning the use of colloidal fuel, the author has no knowledge of this being tried but, as previously mentioned, experiments employing pulverized coal are in progress.

The author wishes to take this opportunity to express his appreciation for the generous response and excellent contributions made by the various discusesrs of his paper.

Australian-Built Locomotive

TO THE EDITOR:

On page 791 of the December, 1944, issue of MECHANICAL ENGINEERING appears an illustration of a 4-6-2 locomotive for the New South Wales Government Railways. It is described as British built, and it will be inferred that it was a product of the British Isles.

The unit was completely designed and built in Sydney, New South Wales, the chief mechanical engineer of the Government Railways being responsible. It is operating with great success.

GEOFFREY INNES DAVEY.[14]

[14] Gutteridge, Haskins & Davey, Sydney, Australia.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Twentieth Century Engineering

TWENTIETH CENTURY ENGINEERING. By C. H. S. Tupholme. Philosophical Library, New York, N. Y., 1944. Cloth, $5^5/_8 \times 8^7/_8$ in., 201 pp., illus., $3.

REVIEWED BY ARTHUR M. GREENE, JR.[1]

THIS book has been written "to record some of the more spectacular engineering progress of the last few years, both during and immediately before the war." Although published in the United States the text draws largely from British and continental practice in the nine chapters: mechanical power, engineering workshop processes, air conditioning and refrigeration, chemical and metallurgical engineering, electrical engineering, traction, marine engineering, aircraft, and physics.

The text covers very many developments of the last few years and indicates possibilities of the future but it is regretted that in including so many devices or processes the descriptions are not adequate for the professional reader to say nothing for the layman for whom the text was intended also. The text also indicates poor proof reading as the description of the Velox boiler on page three does not correspond with the illustration of this structure and on page 78 reference is made to a figure or plates that are not in the index or text.

Under mechanical power the author discusses the Velox boiler, the Sulzer monotube boiler, the mercury boiler and turbine, the use of diphenyls, Diesel engines, superchargers, the dual fuel engine, and the coal dust engine.

In the chapter on engineering workshop processes flame machining is described as well as hardening, softening, and metal deposition by the use of flames. Plating is discussed and the finishing of surfaces with the measurement of surface finish. Various types of gages for dimensions and shapes are considered with illustrations of them.

Air conditioning and refrigeration deals with the requirements of air conditioning for human comfort and for industrial demands as well as the quick freezing of food stuffs, the requirements for low temperatures by the aviation laboratories, and the retardation of age hardening of aluminum alloys. It is regretted that the illustrations and experiences mentioned in this chapter do not include recent American practice and equipment.

Chemical and metallurgical engineering covers the use of plastics in machines, automobiles and aircraft, synthetic rubbers, the machinery for the high pressure synthesis of gases, alloys of ferrous and nonferrous materials, the production of magnesium, welding, the testing of welds by magnetic and X-ray methods, flame hardening, heat-treatment in controlled atmospheres, and electro-forming of products by electro-deposition of metal.

The great number of the applications of the photo-electric cell in industry is the important feature of the chapter on electrical engineering and these are followed by the uses of infrared and ultraviolet rays in criminology, medicine, industry, and the arts. The electric interlocking devices for the movement of bridges are described as well as devices for the recording of physical phenomena and the control of processes when these are located at a distance from the control point.

The recent developments of European locomotives of steam or Diesel drive are given in the chapter on traction with a few references to American practice. Military tanks and drives and some future plans for automobiles are illustrated.

The different methods of ship propulsion including the reversible magnetic coupling and the variable pitch propeller for Diesel drives are discussed in the chapter on marine engineering. This chapter includes discussions of such

[1] Dean Emeritus, School of Engineering, Princeton University, Princeton, N. J. Fellow and Hon. Mem. A.S.M.E.

naval matters as aircraft, aircraft defense, aircraft carriers, and submarines. The author appears to be an advocate of the Velox boiler for in addition to drawings and description of the boiler in the first chapter he gives drawings of the application of it to a locomotive in the chapter on traction and drawings in this chapter as applied to a vessel. He fails to give the other recent forms of boilers for locomotives and for marine propulsion.

The chapter on aircraft reviews "the outstanding characteristics of modern aircraft, and the nature of those technical developments which have made such characteristics possible." The author has chosen examples from the crafts of the Allies and also from the Germans. Armor, armament, engines, superchargers, propellers, instruments, pressure cabins, ventilation, heating, de-icers, and flight controls are subjects which receive consideration.

The splitting of the atom by the use of the cyclotron, the electron microscope, ultra high-speed X-ray photography, and the use of chloral hydrate in restoring burnt manuscripts are among the short notes of chapter 9 dealing with physics.

The book has achieved the object of the author and it will appeal not only to the layman but to engineering specialist whose activities do not cover many of the branches of the profession.

Pageant of Steel

PRINCIPIO TO WHEELING. 1715–1945. A Pageant of Iron and Steel. By Earl Chapin May. Harper & Brothers, N. Y., 1945. Cloth, $5^1/_4 \times 8^1/_2$ in., 335 pages, $3.

REVIEWED BY JOSEPH W. ROE[2]

THIS story of the Wheeling Steel Corporation, which begins at the headwaters of Chesapeake Bay in 1715, is interesting and valuable, especially over the colonial period, as it is based on documentary material, part of which is reproduced in the book.

Joseph Farmer, a Quaker iron-master, representing a group from Shrewsbury, England, selected a site on a creek about five miles east of Havre-de-Grace, named it Principio, and started smelting iron with a few slaves and 20 indentured workmen, alleged blacksmiths, and ex-convicts, "all with a passion for rum." The site was well chosen, having good timber for charcoal, a water power, and tide-water communication. The surrounding ore supply proved meagre, but John England, who succeeded Farmer as manager, bought ore deposits in 1724 at Whetstone Point, near Baltimore which filled the need.

A year later this was supplemented by an agreement with Captain Augustine Washington, father of George Washington, who came into the partnership as a one-sixth owner in consideration for rights to mine excellent ore deposits and operate a furnace on his land near the Potomac. When Captain Washington died in 1743 he left his iron interests to his son Lawrence. At Lawrence's death in 1752 they passed to his brother Augustine, and the Washington family were actively connected with the Principio enterprise for many years. During the colonial period it had four furnaces, two forges, and owned 30,000 acres of land. "More than one half of American pig iron exported to Great Britain originated in Maryland or Virginia lands, owned and mined by Principio."

The Principio buildings were burned by the British during the Revolution, but were rebuilt by Thomas Russell, II, who followed England and operated the furnace until his death in 1786. The properties were confiscated and sold because of their English ownership, except for shares of Russell and the Washingtons which were segregated out to them.

Principio made the cannon for Fort McHenry on their property at Whetstone Point which successfully defended Baltimore in 1814. It was this attack which inspired the Star Spangled Banner. The British, denied victory at Baltimore and knowing where the cannon came from, sailed on up Chesapeake Bay and again destroyed the Principio plant. This time it was restored only slowly, and under several ownerships it resumed operation.

In 1836 George Price Whitaker and Joseph Whitaker, whose father had been weaned from the British army during the Revolution by Thomas Russell and started in the iron business, bought the Principio property. The transfer of their interest to Wheeling came about gradually. The Crescent Iron Works, located there, was a live market for their Principio iron. It got into financial difficulties. To protect themselves they joined in its reorganization and became more and more identified with their Wheeling interests as these increased and their Maryland ones declined.

From the 1850's on the Whitaker family have been active there. George Price Whitaker, one of the principal creditors of the Crescent Manufacturing Co. took over the plant and organized the Whitaker Iron Co., which came into possession of all the old Principio holdings. In 1903 the Whitaker Iron Co. and Laughlin Nail Works merged into the Whitaker Glessner Co. In 1920 this became part of the Wheeling Steel Corporation.

The latter part of the book gives the intricate history of the personalities and firms having part in this development. The long and colorful record of more than 240 years, full of ups and downs, is a picture in miniature of the growth of the iron and steel industry in America.

[2] Southport, Conn. Fellow A.S.M.E.

Books Received in Library

ADSORPTION. By C. L. Mantell. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1945. Cloth, $5^1/_4 \times 8^1/_2$ in., 386 pp., illus., diagrams, charts, tables, $4.50. Practice, rather than theory, is the keynote of this new approach to the subject of adsorption written from the viewpoint of industrial procedure, the designing engineer, and the operator of equipment. Emphasizing its unit operation aspects, the book covers adsorption in industry and discusses such varied fields as refining operations, air conditioning, and elimination of toxic materials. Fuller's earth, activated clays, activated carbons, silica gel, aluminum oxide base materials, and other adsorbents are dealt with.

AERONAUTICAL DICTIONARY. By T. A. Dickinson. Thomas Y. Crowell Co., New York, N. Y., 1945. Cloth, $5^1/_4 \times 8^1/_4$ in., 484 pp., illus., diagrams, charts, tables, $3.50. This comprehensive work gives definitions of over 6000 terms in aerodynamics, meteorology, navigation, piloting, engineering, metallurgy, design, lofting, aircraft construction, and other phases of aeronautics. More than 300 illustrations are used to clarify or amplify certain definitions. An appendix contains many tables of technical data, lists of aeronautical abbreviations, useful books and American periodicals, and other information of value.

AIR COMPRESSORS, Their Installation, Operation, and Maintenance. By E. W. F. Feller. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1944. Cloth, $5^1/_4 \times 8^1/_2$ in., 460 pp., illus., diagrams, charts, tables, $4.50. This handbook is intended for operating engineers and manufacturers interested in the selection, operation, and maintenance of air compressors. The various types and designs are described, their performance discussed, and much practical information is presented in convenient form.

AIRCRAFT VIBRATION AND FLUTTER. By C. R. Freberg and E. N. Kemler. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1944. Cloth, $5^1/_2 \times 8^1/_2$ in., 214 pp., diagrams, charts, tables, $3. In nontechnical language, with a minimum of mathematics, this book explains the fundamentals and general phases of vibration and flutter affecting both stationary-wing and rotating-wing aircraft. The material is arranged to give practical aid in problems of aircraft testing and analysis. Engine isolation and soundproofing are dealt with in an early chapter. There is a bibliography.

AIRCRAFT YEAR BOOK for 1944, twenty-sixth annual edition. Edited by H. Mingos. Lanciar Publishers, New York, N. Y., 1944. Cloth, $5^1/_4 \times 9$ in., 727 pp., illus., diagrams, tables, $6. The new edition of this annual publication of the Aeronautical Chamber of Commerce of America reviews the events of the year, both in military and civil aviation and the work of American manufacturers. Associations, government bureaus, and other organizations interested in aviation are listed with their officers. Statistics and records are tabulated.

ANALYSIS OF DRILL-JIG DESIGN. By J. I. Karash. McGraw-Hill Book Co., Inc., New

York, N. Y., and London, England, 1944. Cloth, $5^{1}/_{4} \times 8^{1}/_{2}$ in., 333 pp., illus., diagrams, charts, tables, \$3. The author presents a systematic approach to the problems of tool design, using drill jigs as a specific case study and outlining fundamental principles that apply in varied degree to all tool-design problems. The process of design is analyzed into a clear-cut procedure, stressing the essential decisions, their proper sequence, and basis of fact for arriving at decisions. Specific examples are used throughout.

ANNUAL REPORT ON THE PROGRESS OF RUBBER TECHNOLOGY, Vol. 7, 1943. Edited by T. J. Drakeley, published by W. Heffer & Sons, Ltd., Cambridge, England, for the Institution of the Rubber Industry, London, S.W.1, England, 1944. Paper, $7 \times 9^{1}/_{2}$ in., 129 pp., 12s 6d. This annual contains excellent reviews of developments in various fields: production, chemistry and physics, synthetic rubber, compounding, fibers and textiles, vulcanized rubber, tires, belting, hose and tubing, cables and electrical insulation, footwear, mechanical goods, flooring, surgical goods, solvents, sponge rubber, hard rubber, works processes, and machinery. Each report includes a bibliography. Name and subject indexes are provided.

CHAMBERS' TECHNICAL DICTIONARY, edited by C. F. Tweney and L. E. C. Hughes, revised edition, with Supplements. The Macmillan Co., New York, N. Y., 1944. Cloth, $5^{1}/_{4} \times 8^{1}/_{4}$ in., 975 pp., diagrams, charts, \$6. This dictionary defines terms used in pure and applied science, in engineering and construction, in manufacturing and the skilled trades. The new edition has been revised and a supplementary list of nearly a thousand definitions added. It is the best work of its kind now on the market.

DEMOCRACY UNDER PRESSURE, Special Interests Vs. the Public Welfare. By S. Chase. Twentieth Century Fund, New York, N. Y., 1945. Cloth, $5^{1}/_{4} \times 8$ in., 142 pp., tables, \$1. In this report to the Twentieth Century Fund Mr. Chase discusses the drift toward monopoly in business, agriculture and labor that is growing in America, and its effect upon postwar adjustment. He names the leading pressure groups, tells why they exist, how they operate, and what they want, and discusses their significance in our future.

CIVIL AVIATION AND PEACE. (America Faces the Air Age, Vol. 2.) By J. P. Van Zandt. Brookings Institution, Washington, D. C., 1944. Cloth, $6 \times 9^{1}/_{4}$ in., 157 pp., illus., diagrams, charts, tables, \$1. The author examines the principal divisions of civil aviation and the relation of each to air power. Past attempts at control of aviation are reviewed and current control proposals are analyzed. The relation between air transport and international economic stability is discussed. In conclusion the author outlines a program of maximum use intended to stabilize international conditions and assure a more prosperous and peaceful world.

COMING AIR AGE. By R. M. Cleveland and L. E. Neville. McGraw-Hill Book Co., Inc., Whittlesey House department, New York, N. Y., and London, England, 1944. Cloth, $5^{1}/_{2} \times 8^{1}/_{4}$ in., 359 pp., illus., tables, \$2.75. This book presents a logical outline of the new developments and problems that can be expected in the aviation world of tomorrow. Beginning with a discussion of the probable status, both technical and financial, of the industry when the war ends, the book goes on to discuss the geography of the air, freedom of the air, air lines, and sky freighting. The giant plane, helicopter, rocket ship, and new power sources, as well as the more typical craft of the predictable future are described. The question of air-age education is considered from both a national and international viewpoint.

DIAMOND TOOLS. By P. Grodzinski. Anton Smit & Co., New York, N. Y., 1944. Cloth, $5^{1}/_{4} \times 8^{1}/_{4}$ in., 379 pp., illus., diagram, charts, tables, \$4.50. This volume gives a survey of the results obtained in the application of diamonds in the following technical branches of industry: hardness testing; truing and dressing grinding wheels; cutting metals, plastics, etc.; machining glass and stone materials; rock drilling; engraving; wire drawing; and the use of diamond dust as abrasive material. Other topics covered are the production and qualities of diamonds, a general discussion of the diamond as technical material, and the use of diamonds and other precious stones as bearings. References are included.

ENGLISH-FRENCH COMPREHENSIVE TECHNICAL DICTIONARY OF THE AUTOMOBILE and Allied Industries. Compiled by L. L. Sell. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1932, reprinted. Fabrikoid, $5^{1}/_{2} \times 7^{1}/_{2}$ in., 768 pp., \$8. This dictionary contains more than 150,000 English and French technical terms used in the automobile and allied industries. The list is a very detailed one, covering many phrases as well as words, and both English and American usage have been considered. As many of the terms apply equally to all branches of mechanical engineering, the dictionary will be useful to translators in a wider field than the title indicates.

ENGLISH-SPANISH AND SPANISH-ENGLISH DICTIONARY OF AVIATION TERMS. By J. K. Serrales. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1944. Fabrikoid, $5 \times 7^{1}/_{2}$ in., 131 pp., \$2.50. Aviation terms used in Spanish America differ considerably from those used in Spain, as more terms have been adopted from the English language. The present work is based on usage in South America.

GERMAN-ENGLISH DICTIONARY OF METALLURGY. By T. E. Singer with foreword by J. Kurtz. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1945. Cloth, $5 \times 7^{1}/_{4}$ in., 298 pp., \$4. This dictionary, which specifically aims at the needs of metallurgists, will be welcomed by all those who need to know technical German. The terminology covers metallurgy and such related subjects as mining, mineralogy, and metal working. A special feature is the attention given to the modern German tendency to eliminate terms of non-German origin, which trouble modern readers. Readers of technical German will find this new glossary of definite value.

HEATING, VENTILATING, AIR CONDITIONING GUIDE, Vol. 23, 1945. Technical Data Section together with a Manufacturers' Catalog Data Section, also Roll of Membership and Complete Indexes. American Society of Heating and Ventilating Engineers, New York, N. Y., 1945. Cloth, $6 \times 9^{1}/_{4}$ in., 1152 pp., also 64 pp. membership list, illustrations, diagrams, charts, tables, \$5. This edition follows the pattern of previous ones, but a change in format has made an opportunity for general revision and an increase in the amount of information. Many chapters have been rewritten wholly or in part, and new data added. The technical section provides all the data ordinarily needed by engineers and architects, thoroughly indexed for quick reference. The catalog section contains information on the products of over two hundred manufacturers, with an index.

HIGH-FREQUENCY INDUCTION HEATING. By F. W. Curtis. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1944. Cloth, $5^{1}/_{4} \times 8^{1}/_{2}$ in., 235 pp., illus., diagrams, charts, tables, \$2.75. The industrial applications of induction heating are explained. Heating procedures and principles and the constructional features of industrial-heating coils are described in detail, and fixture design and process-handling equipment are outlined broadly. The book is intended to simplify the application of induction heating and to assist in the installation of equipment for specific operations.

MANAGEMENT OF INSPECTION AND QUALITY CONTROL. By J. M. Juran. Harper & Brothers, New York, N. Y., and London, England, 1945. Cloth, $5^{1}/_{4} \times 8^{3}/_{4}$ in., 233 pp., \$3. The subject matter of this book divides broadly into four categories: the performance of the actual inspection work, including problems of quality specifications, measurement, accuracy, sampling, etc.; the use of inspection data; the internal organization of the inspection department and its place in the plant organization; and the general philosophy of inspection and quality control, with the necessary management controls for effective co-ordination.

MECHANICAL AND ELECTRICAL EQUIPMENT FOR BUILDINGS. By C. M. Gay and C. De van Fawcett. Second edition. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1945. Cloth, $5^{1}/_{2} \times 8^{1}/_{2}$ in., 453 pp., illus., diagrams, charts, tables, \$5. The coverage of this manual is indicated by the headings of the five sections: water supply; plumbing and drainage; heating and air conditioning; electrical equipment; and acoustics. The purpose of the book is to acquaint architects, students, and building managers with the basic theories and applications concerned with building equipment, rather than to provide a handbook for complicated design and specifications. This edition has been considerably rewritten to conform with modern practice and the latest recommendations and provisions of the pertinent codes and standards.

METALLURGICAL STUDY OF GERMAN AND ITALIAN AIRCRAFT ENGINE AND AIRFRAME PARTS. By the Aero Components Sub-Committee of the Technical Advisory Committee to the Special and Alloy Steels Committee, arranged in co-operation with the Committee, by C. A. Otto, Editor of *Metallurgia*. The Kennedy Press, Ltd., London, England, 1943. Cloth, $5^{1}/_{2} \times 9^{1}/_{2}$ in., 140 pp., illus., diagrams, charts, tables, 10s 6d. This report constitutes a summary of data resulting from the metallurgical examination of German and Italian aircraft. The principal object of these investigations was to obtain data on the types and quality of materials used, methods of manufacture, efficiency of heat-treatment, etc. The emphasis is on engine parts although airframe components are also considered. The information is detailed, and a certain amount of critical analysis is included.

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MODERN SYNTHETIC RUBBERS. By H. Barron. Second edition revised and enlarged. D. Van Nostrand Co., Inc., New York, N. Y., 1944. Cloth, $5^{1}/_{2} \times 8^{3}/_{4}$ in., 355 pp., illus., diagrams, charts, tables, \$6.50. The primary purpose of this book, which appeared in 1942, was to awaken Great Britain to the growing importance of synthetic rubber. It presented a systematic account of the new material, considered historically, scientifically, and technically, as revealed in the literature. The present edition has been thoroughly revised to take account of developments since 1942, especially those resulting from work in the United States.

PARTIAL DIFFERENTIAL EQUATIONS OF MATHEMATICAL PHYSICS. By H. Bateman. Dover Publications, New York, N. Y., 1944. Fabrikoid, $6 \times 9^{1}/_{2}$ in., 522 pp., diagrams, tables, \$3.95. Methods are presented for solving boundary value problems of mathematical

TDRI march '45

Has 1932 English ed. [illegible] read somewhere that they [illegible] the same material!

physics by means of definite analytical expressions. The work is restricted to partial differential equations, with only brief mention of the Heaviside calculus and the theory of integral equations. The book contains a wide range of representative problems and nearly 1200 references to classical and contemporary literature. It is intended as both a text and reference work for mathematicians, physicists, aeronautical, electrical, and mechanical engineers.

PERSONNEL RELATIONS. By J. E. Walters. Ronald Press Co., New York, N. Y., 1945. Cloth, 6 × 9$^1/_2$ in., 547 pp., charts, tables, $4.50. This book endeavors to set forth both principles and practice in the field of present-day personnel relations. It includes the varying phases of personnel relations as they are determined and influenced by workers in labor unions, managements, the government, individual employees, labor-management co-operation, and personnel-relations techniques and procedures. The author's further intent is to present personnel relations from positive democratic viewpoints of those actively concerned. The material is based on the author's extensive personal experience plus outside collaboration.

PIONEERING THE HELICOPTER. By C. L. Morris. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1945. Cloth, 5$^1/_2$ × 8$^1/_4$ in., 161 pp., illus., diagrams, maps, $2.75. The author became chief test pilot for Sikorsky Aircraft in 1941 and held that position during the next three years. His story is an interesting, personal one, showing the steps by which success has been reached and discussing future possibilities. A readable account, which will correct various misconceptions.

PROCESS EQUIPMENT DESIGN. By H. C. Hesse and J. H. Rushton. D. Van Nostrand Co., Inc., New York, N. Y., 1945. Cloth, 6 × 9$^1/_4$ in., 580 pp., illus., diagrams, charts, tables, $7.50. This book presents the fundamentals of mechanics, machine and structural elements, and economic and manufacturing considerations related to the design of process equipment, particularly for the chemical industries. The treatment resolves equipment into structural elements in the order of their increasing analytical complexity. Emphasis is placed upon formal methods of stress analysis to insure proper perspective in relation to governing codes. Ease and economy of fabrication and protection against chemical or corrosive action have also been emphasized.

PRODUCTION ENGINEERING IN THE AIRCRAFT INDUSTRY. By A. B. Berghell. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1944. Cloth, 5$^3/_4$ × 9 in., 307 pp., diagrams, charts, tables, $3. A practical text embodying principles, illustrated by specific cases, questions, and answers, for the solution of common problems encountered in the aircraft industry. The author explains the application of principles of estimating new contract costs, budgeting and scheduling direct labor hours, controlling work in process through the use of time standards, work simplification, material saving, and statistical and graphical reports. An appendix contains a glossary and many useful data tables.

PRODUCTION-LINE TECHNIQUE. By R. Muther, with a foreword by E. H. Schell. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1944. Cloth, 5$^3/_4$ × 9 in., 320 pp., illus., diagrams, charts, tables, $3.50. This book is designed for industrial executives who are considering the application of production-line methods to their manufacturing operations. Particularly, its purpose is to present the possibilities of the production line in the medium-sized plant, which heretofore has operated on a job-lot basis. Based on first-hand field investigations of current practices, this book explains the fundamentals of production lines, compares them with job-lot manufacture, and shows how production lines are set up and operated. Their advantages and limitations are pointed out.

REFRIGERATION AND AIR CONDITIONING ENGINEERING. By B. F. Raber and F. W. Hutchinson. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1945. Cloth, 6 × 9$^1/_4$ in., 291 pp., diagrams, charts, tables, $4. In this volume, refrigeration and air conditioning are treated as sciences rather than as arts. The treatment is rigorous and restricted to fundamental principles and rational procedures. Descriptive material and performance data on actual equipment are omitted. Emphasis is placed on graphical solutions, and time-saving charts are numerous. The book is designed to be a reference book for practising engineers, as well as a text for engineering students.

SPLICING WIRE AND FIBER ROPE. By R. Graumont and J. Jensel. Cornell Maritime Press, New York, N. Y., 1945, Cloth, 7 × 10 in., illus., diagrams, tables, $2. A very specialized skill is clearly explained and demonstrated in text and pictures for the benefit of all those who have frequent occasion to handle wire or fiber rope. The rigging of blocks and tackles is included, and a complete glossary of rope terms concludes the work.

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WOOD TECHNOLOGY. By H. D. Tiemann. Pitman Publishing Corporation., New York, N. Y., and Chicago, Ill., 1944. Cloth, 6×9$^1/_2$ in., 328 pp., illus., diagrams, charts, tables, $4. The beginning chapters of this comprehensive work discuss the structure of wood and present a method for identifying different kinds of wood by visible structure. The chemistry of wood and cellulose precedes information on the making of pulp and paper from wood. Moisture relations of wood and the problem of shrinkage and swelling are dealt with, followed by drying and gluing practices. Mechanical and physical properties under varying conditions are evaluated. Biological destructive agencies and their prevention are briefly discussed. A list of references accompanies each chapter.

A.S.M.E. BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval and then is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of March 16, 1945, and approved by A.S.M.E. Council on April 16, 1945.

CASE No. 981 (REOPENED)

(Special Rule)

Inquiry: Is it permissible to use the following A.S.T.M. Emergency Alternate Provisions affecting existing Code specifications: EA-A30(SA-30), EA-A70a (SA-70), EA-A83(SA-83), EA-A89(SA-89) EA-A95(SA-95), EA-A135(SA-135), EA-A157(SA-157), EA-A158a(SA-158), EA-A178(SA-178), EA-A192(SA-192), EA-A194(SA-194), EA-A201(SA-201), EA-A202(SA-202), EA-A203(SA-203), EA-A204(SA-204), EA-A206(SA-206), EA-A209(SA-209), EA-A212(SA-212), EA-A213a(SA-213), EA-A216a(SA-216), EA-A217(SA-217), EA-A226a(SA-226), EA-A240(SA-240), EA-A249a(SA-249), EA-A250(SA-250), EA-B12(SB-12), EA-B61(SB-61), EA-B62b(SB-62), EA-B111(SB-111), EA-B171(SB-171)?

Reply: It is the opinion of the Committee that the aforementioned A.S.T.M. Emergency Alternate Provisions in corresponding Code specifications may be considered as meeting the intent of the Code.

CASE No. 1020

(Interpretation of Par. U-208c)

Inquiry: May the proposed revision of Par. U-208(**c**), suspending the requirement that all cylindrical specimens be sectioned prior to examination, as published in the February, 1945, issue of MECHANICAL ENGINEERING, be made effective immediately?

Reply: Since no adverse comment has been received and no changes are indicated in the proposed revision of Par. U-208(**c**), it is the opinion of the Committee that the following revised form of the second section of this paragraph may be used in place of the present form, pending the issuance of the customary schedule of revisions in the form of addenda sheets:

"The specimens shall be ground or otherwise smoothed and then etched by any method or solution which will reveal the defects without unduly exaggerating or enlarging them (See Par. UA-85)."

A.S.M.E. NEWS

And Notes on Other Engineering Activities

A.S.M.E. Members to Be Represented by Proxy at 1945 Semi-Annual Business Meeting, Chicago, June 18

Attendance Limited to Commuting Area of Chicago

BECAUSE of the O.D.T. ban on meetings, the 1945 Semi-Annual Meeting of The American Society of Mechanical Engineers, to be held at the Hotel Stevens, Chicago, Ill., will consist of a Business Meeting on June 18, at which members of the Society will be represented by proxy, and a meeting of the Council of the Society, with sessions on June 17 and 18.

Attendance of Society members, other than members of the Council, will be limited to those residing in the suburban commuting area of Chicago. The O.D.T. regulations permit 50 persons to travel and use hotel facilities for purposes of a meeting, but the required attendance of members of the A.S.M.E. Council and certain committeemen whose presence is necessary to conduct the business of the Council and the Society practically exhausts this quota. Hence in conformance with the spirit of the "ban," other members of the Society outside the Chicago area cannot be invited to attend the meeting.

On April 17 a letter was sent to every member of the Society explaining the unusual conditions under which the 1945 Semi-Annual Meeting must be conducted. With this letter was sent a proxy by means of which a member will be able to be represented at the Business Meeting. The Constitution of the Society requires the holding of business meetings at Annual and Semi-Annual meetings of the Society. The proxy is the only practicable means by which a member living outside the Chicago area can be represented at the Business Meeting in view of the ban on national conventions.

Chicago Section Will Hold Technical Meeting, June 18 and 19

Concurrently with the 1945 Semi-Annual Meeting, the Chicago Section will hold a meeting of the Section, June 18 and 19. Several papers originally scheduled for the national meeting will be presented. All sessions will be held at the Hotel Stevens. As there are more than 1000 A.S.M.E. members in the Chicago area, attendance at the technical sessions should be representative even without members from out of town who cannot be present because of the ban on meetings.

A tentative program of the meeting follows:

Official Notice

A.S.M.E. Business Meeting

THE Semi-Annual Business Meeting of the members of The American Society of Mechanical Engineers will be held Monday morning, June 18, 1945, at 11:00 a.m. at the Hotel Stevens, Chicago, Ill.

(*Signed*) C. E. Davies
Secretary

FRIDAY, JUNE 15

9:30 a.m.

Committee on Local Sections (all day.)

SATURDAY, JUNE 16

9:30 a.m.

Conference Sections Group Delegates (all day.) (This is subject to favorable action by regional conferences.)

SUNDAY, JUNE 17

10:00 a.m.

Meeting of Executive Committee of the Council

2:00 p.m.

Council Meeting.

MONDAY, JUNE 18

9:00 a.m.

Council Meeting

11:00 a.m.

Business Meeting of the Society

12:15 p.m.

Luncheon, Airplanes of the Future, and Future of the Airplane, by D. R. Shoults, vice-president, Bell Aircraft Corporation, Buffalo, N. Y. Illustrated by technicolor motion pictures.

2:30 p.m.

Management (I)

On the Art of Management, by W. R. Williamson, Mem. A.S.M.E., consulting engineer, Chicago, Ill.

The Art of Cutting Metals, by O. W. Boston, Mem. A.S.M.E., University of Michigan, Ann Arbor, Mich.

MONDAY (*Continued*)

Power

Irreversibility in the Theoretical Regenerative Steam Cycle, by R. E. Hansen, mechanical engineer, Ebasco Services, Inc., New York, N. Y.

6:00 p.m.

Buffet Dinner served smorgasbord style—Introduction of new officers of the Chicago Section followed by informal reception to members of the A.S.M.E. Council. Address, "Personal and Personnel Problems of Engineers," by W. J. King, Battelle Memorial Institute, Columbus, Ohio

8:15 p.m.

Aviation

Gas Turbines in Aviation

The Place of the Gas Turbine in Aviation, by Charles D. Flagle, Jun. A.S.M.E., design engineer, Aviation Gas-Turbine Division, and F. W. Godsey, Manager of the New Products Division, Westinghouse Electric Corporation, Essington, Pa.

Gas-Turbine Fundamentals, D. D. Streid, Jun. A.S.M.E., project engineer, supercharger engineering division, General Electric Co., Lynn, Mass.

Metal Cutting (I)

Joint auspices Research Committees on Metal Cutting Data and Cutting Fluids

Measurements of Temperatures in Metal Cutting, by A. O. Schmidt, Mem. A.S.M.E., research engineer, Kearney & Trecker Corp., Milwaukee, Wis., O. W. Boston, Mem. A.S.M.E., and W. W. Gilbert, Jun. A.S.M.E., University of Michigan, Ann Arbor, Mich.

Machinability of Carbon and Alloy Steels, by G. P. Witteman, metallurgist, Bethlehem Steel Co., Bethlehem, Pa.

Management (II)

The Practical Side of Production Control, by Harry C. Gunetti, Joshua Hendy Iron Works, Sunnyvale, Calif.

TUESDAY, JUNE 19

9:15 a.m.

Production Engineering

An Investigation of Radial Rake Angles in Face Milling, by J. B. Armitage, Mem. A.S.M.E., and A. O. Schmidt, Mem.

TUESDAY (*Continued*)

A.S.M.E., research engineer, Kearney & Trecker Corporation, Milwaukee, Wis.

Evaluation of Ball and Roller Bearing Greases in Electric Motors, by H. A. McConville, General Electric Co., Schenectady, N. Y.

Testing of Precision Lathe Spindles, by G. M. Foley, Battelle Memorial Institute, Columbus, Ohio

Applied Mechanics

Electric Turret Traversing Mechanism for Tanks, by S. J. Mikina, Mem. A.S.M.E., Westinghouse Electric Corporation, East Pittsburgh, Pa.

Design of Beams of Long Span and Low Specific Strength, by I. Opatowski, Mem. A.S.M.E., Armour Research Foundation, Chicago, Ill.

12:15 p.m.

Luncheon, Disposal of Surplus Machine Tools, by A. G. Bryant, vice-president, Cheereman Machine Co., Chicago, Ill.

2:30 p.m.

Gas Turbines

Joint Auspices of Oil and Gas Power Process Industries and Power Divisions

Operations Report on Gas Turbine Use in Oil Refineries, by A. E. Pew, Jr., Sun Oil Company, Philadelphia, Pa.

Heat Transfer

Heat Transfer From a Cylindric Surface to Air, by Max Jakob, Mem. A.S.M.E., Illinois Institute of Technology, and W. M. Dow, Armour Research Foundation, Chicago, Ill.

Metal Cutting (II)

Joint auspices Research Committees on Metal Cutting Data and Cutting Fluids

High-Speed Milling of Steel, by A. Wm. Meyer, Mem. A.S.M.E., Industrial Dept., Brown & Sharpe Mfg. Co., Providence, R. I.

A Slow Motion Study of Hypermilling, by Lt. Col. E. G. Moffat, works manager, Watervliet Arsenal, Watervliet, N. Y., and M. F. Judkins, Mem. A.S.M.E., chief engineer, Firthite Div., Firth-Sterling Steel Co., McKeesport, Pa.

Substitution of Lower-Quality Industrial Diamonds in Diamond Dresser Tools, by H. Whittaker, Koebel Diamond Tool Co., Detroit, Mich.

6:00 p.m.

Social Hour

7:00 p.m.

Annual Dinner of the Chicago Section followed by entertainment and dancing. Presiding: F. H. Lane, chairman, Chicago Section. Speakers: President Alex D. Bailey and guest speaker, Robert E. Wilson, chairman of the board of directors, Standard Oil Company (Ind.), whose subject will be "America's Future Oil Supplies."

Diesel Engines Discussed by Engineers at All-Day Meeting in Cleveland, May 10

Special Program Planned as Partial Substitute for 18th National Oil and Gas Power Conference

SPONSORED jointly by the Oil and Gas Power Division and the Cleveland Section, of The American Society of Mechanical Engineers, a one-day wartime emergency meeting on Diesel-engine design and research was held May 10 at the Hotel Statler in Cleveland. More than 200 engineers from the Cleveland area attended the sessions of this local meeting.

This special program was planned as a partial substitute for the 18th National Oil and Gas Power Conference, originally scheduled to be held in Milwaukee, May 23–25 and postponed because of the government ban on national meetings. In the hope that it will again be possible to hold meetings next spring, the National Oil and Gas Power Conference has been tentatively scheduled for June 12–15, 1946, in Milwaukee.

A number of exceptionally valuable and timely papers prepared for the postponed Milwaukee meeting were grouped to make a one-day program and in accordance with the Society's announced policy of increased local-meeting activities were scheduled for Cleveland. The Cleveland Section, under the leadership of W. G. Stephan, chairman, and E. R. McCarthy, secretary-treasurer, co-operated with the Oil and Gas Power Division to make this meeting a success. It thus became possible to give these interesting papers presentation before an audience of Diesel engineers, Cleveland being a center of engine and accessory manufacture.

Diesel-Engine Bearings

The morning session, under the chairmanship of E. J. Kates, began with a paper by L. M. Tichvinsky, vice-president in charge of engineering, American Bearing Corp., St. Louis, Mo., titled "Diesel-Engine Bearings—Discussion of Failures and Progressive Inspection Methods." The paper described the conditions under which the various Diesel bearings operate and cited seven common causes of bearing failure. Photographs of bearing surfaces illustrated the nature of these types of failure. Mr. Tichvinsky closed the presentation with a discussion of inspection procedures and maintenance methods. The paper was published in the May, 1945, issue of MECHANICAL ENGINEERING.

Supercharging Diesel Engines

In the second paper of the morning session, "Design Aspects of Supercharged Diesel Engines," R. L. Boyer, chief engineer, Cooper-Bessemer Corp., Mt. Vernon, Ohio, analyzed the considerations involved in design of engines that are to be supercharged. From experience gained in production of engines of medium size he discussed such factors as number of valves, valve timing, piston design, and cylinder pressures. By means of polar diagrams, Mr. Boyer showed the effect of supercharging on bearing pressures and then went on to consider the problem of heat dissipation and cooling. The paper was concluded with discussions of fuel consumption, manifolding, and silencing.

Between morning and afternoon sessions, more than 150 of the engineers attending the meeting gathered for luncheon and heard brief addresses of welcome from C. E. Beck, chairman of the Oil and Gas Power Division, and W. G. Stephan, chairman of the Cleveland Section.

Tuning Exhaust Pipes

The afternoon session, under the chairmanship of C. W. Good, began with a paper "Polar Diagram for Tuning of Exhaust Pipes," by Troels Warming, mechanical engineer, Nordberg Manufacturing Company, Milwaukee, Wis. Citing the advantages of proper design of exhaust systems, Mr. Warming analyzed the mathematical problem involved in arriving at correct proportions and derived a simplified method for such analysis. By means of polar diagrams, usual complex calculations can be eliminated and characteristics of an exhaust system determined with relative ease.

Measuring Flame Temperatures

The program was completed by presentation of "Flame-Temperature Measurements in Internal-Combustion Engines," by O. A. Uyehara, P. S. Myers, K. M. Watson, and L. A. Wilson, all of the mechanical engineering department, University of Wisconsin, Madison, Wis. Mr. Myers, in presenting the paper, discussed the general problem involved in determination of flame temperatures in engine cylinders and outlined the procedures followed in research work on this subject at the University of Wisconsin. The instrumentation employed was described in some detail and data already obtained in this continuing program were presented. This paper, and all the others, will be published, as will the discussion that followed presentation.

L. S. Marks Lectures in Evening

To round out a day devoted to the internal-combustion engine, about 1000 members of A.S.M.E. and guests were present at a special meeting in the evening to hear Prof. Lionel S. Marks discuss the present status and future prospects of the gas turbine. This was one of a series of lectures that Professor Marks is presenting in various parts of the country, under auspices of A.S.M.E.

W. F. Durand Honored

AT the annual dinner of the National Academy of Sciences held on April 23, the Carty Medal was awarded to Dr. W. F. Durand, past-president and honorary member A.S.M.E., with the following citation:

"The National Academy of Sciences of the United States of America at its Annual Meeting of the year 1945 in Washington presents to William Frederick Durand—in his profession, a versatile and creative engineer; among his colleagues, a wise and friendly counselor; before his students, a kindly and inspiring teacher; to the nation, an able and devoted servant—the Fifth John J. Carty Medal and Award for the Advancement of Science, consisting of the Carty Medal and an honorarium of twenty-five hundred dollars."

President's Page

The Engineer's Duty as a Citizen

PROBABLY few members realize that in the By-Laws of our Society, in Article B-2, under the heading of "Purposes," are these two phrases: "Encouraging a high standard of citizenship among engineers," and "encouraging engineers to participate in public affairs." Fewer still appreciate the importance of carrying out these two activities if our Society's objectives are to be fulfilled.

While it is the duty of every citizen to interest himself and if possible participate in public affairs as a responsibility of citizenship, it is particularly important that engineers should be good citizens in the fullest meaning of the term. Since the engineer is playing an increasingly important part in our economic development and well-being, he must realize that activity in technical affairs is not sufficient if he is to do his full duty to his community and to his profession.

To quote from Senator Elbert D. Thomas' book, "Thomas Jefferson, World Citizen:"

"Jefferson saw education as the indispensable element to make The American Experiment workable—practical. It was his concern for the success of the government which made him the great champion of universal education. He would not educate the citizens for their own improvement, or the mere pleasure of living, but that they might govern themselves successfully." This is equally true today and it is more necessary than ever before in the history of our country.

In an address before the Society in 1910, on "The Engineer's Duty as a Citizen," Rear Admiral George Wallace Melville made the following statement:

"In view of the enormously important part which the engineer plays in life today, it is incumbent upon him, more than upon most other men, to take a vital interest in the work of government and to lend his trained ability and judgment to its perfection . . . What I am pleading for is a habit of mind that will cause engineers to take an active part in all public questions, great or small, where their knowledge will enable them to contribute to the common good."

Dr. John Dickinson in the *Journal of the American Philosophical Society* in 1943, stated:

"One of the strangest aspects of our unusual political era is that a majority of those who are performing the most important and responsible functions in the general activities of community life, industrial, financial, social, philanthropic, and professional, have little or no influence in the conduct of actual political affairs."

These statements are typical of warnings sounded by leaders and students of our form of government all during our history and are particularly applicable during the present intense era with its relatively high standards of living created by engineers and dependent on them.

The Engineers' Civic Responsibilities Committee of your Society is preparing a citizenship program for the consideration of the Sections, is working with those directing our educational institutions, and is becoming increasingly active in bringing this subject to the attention of our members. It is high time that engineers as a group recognize the responsibility of citizenship and take an active part in the civic affairs of their communities and in State and National affairs as well.

(*Signed*) Alex D. Bailey, *President*, A.S.M.E.

Actions of A.S.M.E. Executive Committee

At Meeting Held at Headquarters, April 27, 1945

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society on April 27, 1945. There were present: Alex D. Bailey, chairman, R. F. Gagg, vice-chairman, A. C. Chick, D. W. R. Morgan, and A. R. Stevenson, Jr., of the Committee; J. J. Swan (Finance), A. R. Mumford (Local Sections), J. H. Sengstaken (Professional Divisions), R. M. Gates, junior past-president, W. H. Larkin (Nominating Committee); C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary.

The following actions were of general interest.

Certificate of Award

The request of the Finance Committee for a Certificate of Award to K. W. Jappe, retiring member of the Finance Committee, was approved.

Scientific Apparatus Makers of America

Approval was voted of the appointment of Karl Hubbard as liaison representative of the Scientific Apparatus Makers of America to the Industrial Instruments and Regulators Division.

Plant Layout

Approval was voted of the initiation of a new standards project on "Three-Dimensional Plant-Layout Models."

Charles T. Main Award

The topic "Creative Engineering as a Factor in Promoting Full Employment" was approved for the 1946 Charles T. Main Award.

Industrial Conservation Committee

On recommendation of the Management Division it was decided that the Special Committee on Conservation should function under the auspices of that division.

Development Fund

It was reported that as of April 27, 1945, the Development Fund had received $82,396 from 145 contributors.

International Relations

Action of the Executive Committee on March 23, 1945, providing for a Committee on International Relations consisting of three members, was modified to provide an administrative committee of five members, each to serve a five-year term, and advisory members, to be selected each year, the retiring chairman of the administrative committee to be eligible for membership on the advisory group. Appointed to serve on the administrative committee, with terms expiring in the years indicated, were: Robert M. Gates, chairman (1946), Ernest Pragst (1947), Joseph Pope (1948), Ralph S. Damon (1949), and Fenton B. Turck (1950). The following were appointed to serve as advisory members: William L. Batt, Wallace Clark, Morris L. Cooke, Howard Coonley, Col. P. R. Faymonville, Arthur M. Greene, Jr., Henry A. Lardner, H. S. Pratt, and Major General Charles M. Wesson.

Inter-American Engineering Co-Operation

The resignation of Arthur M. Greene, Jr., as A.S.M.E. representative on the Inter-American Engineering Co-Operation Committee was accepted with regret.

Society Organization Structure

Approval was voted of the following recommendations of the Committee on Society Organization Structure:

A vice-president shall be the leader of the Society in his region and its responsible representative on the Council, the governing body of the whole Society. He shall preside at all group meetings of local sections and of his regional executive committee and shall bring to meetings of the Council the views, needs, and problems of his district, taking back to it the combined judgment of the members of the Council. He shall be concerned with the successful functioning of the sections and branches in his region and for the administration of the national programs which affect them, while preserving the autonomy of the local sections within his group.

He shall endeavor through his regional executive committee to further the selection of the best candidates available for officers, for the Nominating Committee, and for other committee memberships, and shall promote the increase of qualified membership in the Society throughout his district.

He should recognize and promote the interest of region membership in civic affairs without partisan or other political activity and should promote and maintain the high standards of the Society with regard to state licensing.

He shall call to the attention of his regional executive committee and Society headquarters the need for special meetings of the Society within his region at such times and covering such topics as shall be most timely and for the best interests of the Society.

Consulting Engineering Group

Approval was voted of the appointment of Stewart F. Robertson as secretary of the Consulting Engineering Group.

Trump Memorial

It was reported that the Committee on Dues-Exempt Members' Contributions had agreed to contribute $50 from its fund toward the establishment of an alcove of engineering books in the Syracuse Public Library as a memorial to Edward N. Trump of Syracuse, who was an honorary member of the Society.

1944 Group Delegates Conferences

Statements of the Council actions on the recommendations of the 1944 Group Delegates Conference were adopted.

Public Works

On April 7 General Philip B. Fleming, administrator, Federal Works Agency, informed the Society that a Public Works Construction-Industry Advisory Committee had been authorized and asked for the Society's approval of the committee. Approval was voted and S. Logan Kerr was appointed A.S.M.E. representative on the Advisory Committee.

Column Research Council

An invitation to participate in the formation of a Column Research Council under Engineering Foundation was accepted, and L. H. Donnell, S. Timoshenko, and H. L. Whittemore were designated A.S.M.E. representatives on the Council.

Death of President Roosevelt

The Secretary reported that the Society had received a cablegram from the President of The Institution of Mechanical Engineers of Great Britain, extending sympathy in "the tragic loss your country and the world has sustained in the death of your great President." A similar cablegram was also received from a Fellow Member of the Society in Sweden, Alex Engblom.

Hollis P. Porter

The Secretary reported the death, on Jan. 22, 1945, of Hollis P. Porter, manager of the Society, 1921–1924.

Appointments

The following appointments were approved:

Boiler Code Subcommittee on Ferrous Materials, B. F. Miller.

Sectional Committees on Safety Code; Conveyers and Conveying Machinery, W. C. Hudson; Use, Care, and Protection of Abrasive Wheels, John W. Sterrett.

Hoover Medal Board of Award, Harvey N. Davis (six years).

Student meetings: May 7, Dallas, Texas, Southern Methodist University, J. A. Noyes; May 11, Evanston, Ill., Northwestern University, Alex D. Bailey; May 12, Cambridge, Mass., Massachusetts Institute of Technology, A. C. Chick; May 16, Hoboken, N. J., Stevens Institute of Technology, R. F. Gagg.

Machine Tool Export Group Formed

FOUR manufacturers of machine tools have formed A.M.T.E.A. Corporation (American Machine Tool Export Associates) to be made up entirely within the machine-tool industry to serve export business. A.M.T.E.A. includes as initial stockholders the Landis Tool Company, Waynesboro, Pa., manufacturers of precision grinding machinery; Lodge and Shipley Machine Tool Company, Cincinnati, Ohio, manufacturers of engine lathes; Kearney & Trecker Corporation, Milwaukee, Wis., manufacturers of milling machines, Warner & Swasey Company, Cleveland, Ohio; manufacturers of turret lathes. The addition of more member machine-tool manufacturers of other types of equipment is planned so that A.M.T.E.A. Corporation will be in position to offer to the trade all types of machine tools in common use. All future member companies will become stockholders in the corporation.

A.M.T.E.A. Corporation has been organized to consolidate the efforts of manufacturers in a co-ordinated program of sales, engineering, and service to the expanding industrial market in Latin America. A.M.T.E.A. will operate with its own capital, buying directly from the member manufac-

turers and selling to the trade throughout Latin America.

A.M.T.E.A.'s board of directors have been elected officers of the organization. Joseph L. Trecker, executive vice-president of Kearney & Trecker Corporation, was elected president of A.M.T.E.A.; Walter K. Bailey, vice-president of Warner & Swasey Company, was elected vice-president; M. A. Hollengreen, vice-president of Landis Tool Company, was elected vice-president; and William L. Dolle, president of Lodge & Shipley Machine Tool Company, was elected secretary-treasurer. Fred M. Read, foreign sales manager of Kearney & Trecker Corporation, has been named general manager.

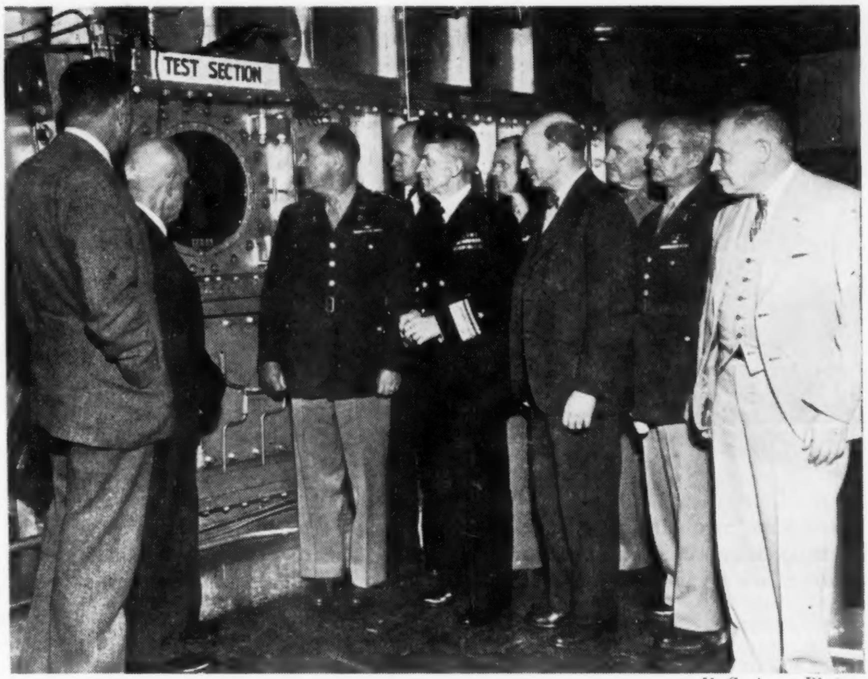
Offices of A.M.T.E.A. Corporation are in the Empire State Building, 350 Fifth Avenue, New York, N. Y.

A.S.M.E Members Are Welcomed at I.M.E. in London

THE Institution of Mechanical Engineers will be glad to put its facilities at the disposal of A.S.M.E. members in the Armed Forces of the United States or in Government employ while they are visiting in London.

A letter recently received at A.S.M.E. headquarters from H. L. Guy, secretary of the Institution, suggests that A.S.M.E. members in London call at the Institution, Storey's Gate, St. James's Park, and make themselves known. They will be cordially greeted, provided with information about forthcoming meetings, and given a card which will admit them equally with members of the Institution.

The headquarters of the Institution is a magnificent building, centrally and conveniently located facing St. James's Park. Next to it, will be found the equally impressive headquarters of The Institution of Civil Engineers. Many famous London landmarks are in the immediate vicinity.



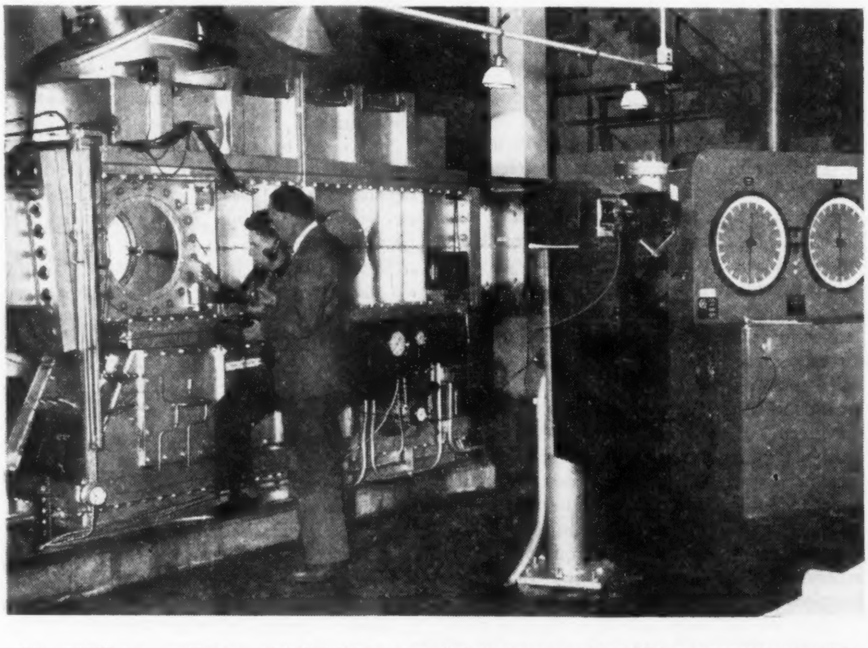
U. S. Army Photo

VIEWING THE NEW SUPERSONIC WIND TUNNEL AT ABERDEEN PROVING GROUND

(*Left to right:* Dr. Edwin P. Hubble; Dr. W. F. Durand, National Academy of Sciences; Lieut. Gen. L. H. Campbell, Jr.; Rear Admiral G. F. Hussey, Jr., Chief, Bureau of Ordnance, U.S.N.; Rear Admiral J. A. Furer, Assistant Chief of Staff to Fleet Admiral King; Maj. Gen. G. M. Barnes; Dr. Jerome C. Hunsaker, N.A.C.A.; Maj. Gen. Charles T. Harris, Jr.; Col. George G. Eddy; Robert H. Kent.)

Supersonic Wind Tunnel Dedicated at Aberdeen Proving Ground

A POWERFUL instrument of ballistic research, the Supersonic Wind Tunnel, was dedicated at Aberdeen Proving Ground on May 9, 1945, by Lieut. Gen. L. H. Campbell, Jr., honorary member A.S.M.E., Chief of Ordnance, U. S. Army. This important laboratory, which will have great value in the design of high-speed missiles of the future, cost two million dollars and is equipped to measure the forces on projectiles traveling at speeds up to 3000 miles per hour.

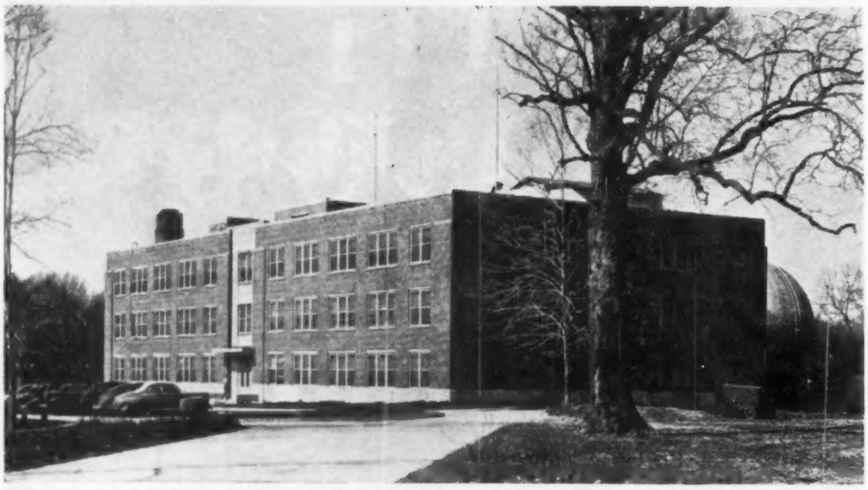


DR. EDWIN P. HUBBLE, ASTRONOMER AND CHIEF OF THE EXTERIOR BALLISTICS BRANCH OF THE BALLISTICS LABORATORY, CONSIDERS SCALE-MODEL BOMBS WITH HIS ASSISTANT, LIEUT. MARIO W. CONTI, AT THE BOMB WIND TUNNEL OF THE SUPERSONIC LABORATORY

The simple dedicatory ceremonies took place before a small group of leaders, scientists, and top ranks of the Armed Forces. Maj. Gen. Charles T. Harris, Jr., Commander General of Aberdeen Proving Ground, the great research center of Army Ordnance, called the meeting to order and introduced General Campbell who paid tribute to the scientists and engineers who made the tunnel possible. He dedicated it to the cause of peace; a peace that comes when the better weapons are in the hands of the nations which have a passion for peace.

Dr. William F. Durand, past president and honorary member A.S.M.E., told of his work as chairman of a board appointed by the National Academy of Sciences to appraise the proposal made by the Ordnance Department in 1940 that such a tunnel be built. Dr. Durand developed its usefulness in war and as a deterrent of future war and emphasized the fact that the tunnel would have a tremendous value to industry in measuring many of the factors, now unknown, that have a bearing on high-speed-machinery design and construction.

Col. G. G. Eddy, in charge of the Research Center at Aberdeen, and Dr. Robert H. Kent, in charge of exterior ballistics, spoke of the importance of the tunnel. He described one job performed in the tunnel which avoided a



THE NEW TWO-MILLION-DOLLAR SUPERSONIC WIND TUNNEL LABORATORY OF THE ORDNANCE RESEARCH AND DEVELOPMENT CENTER, ABERDEEN PROVING GROUND, MD., WHERE AIR SPEEDS OF MORE THAN 1300 MILES AN HOUR ARE ATTAINED TO TEST BOMBS AND PROJECTILES

design and construction mistake on a projectile that saved the first cost of the tunnel.

Dr. Edwin P. Hubble, director of the tunnel, then explained the detailed workings of the device and Lieut. M. W. Conti put it through its paces on a scale model of a new projectile. The visitors were able to read the forces and see the pictures of the shock wave set up.

This tunnel will be described in detail in a later issue of MECHANICAL ENGINEERING.

Safety Color Code Submitted for Approval

A WAR Committee of the American Standards Association has been working for some months by specific request of the War Department on a Safety Color Code for Marking Physical Hazards. At a recent meeting held in New York, this committee considered a volume of comment and suggestions on the standard received in the past three months and voted to submit their newly drafted standard for approval as an American War Standard.

Briefly, the standard is a codification of certain already widely recognized concepts regarding use of color for safety purposes.

Red is indicated for the identification of (1) fire-protection equipment and apparatus, (2) danger, (3) to indicate "Stop."

Yellow is indicated for caution, and for marking physical hazards such as: striking against, stumbling, falling, tripping, etc.

Green is indicated for safety and location of first aid equipment.

White, black, or a combination of the two, for housekeeping, and traffic markings.

Much of the standard deals with suggested applications for these colors such as the marking of safety cans, fire sirens, posts, hand rails, unguarded edges of platforms, location of gas masks, stretchers, etc.

The draft standard will be revised in accordance with decisions reached at the meeting and then sent to letter ballot of the whole War Committee, first step in its final approval as a War Standard by the American Standards Association.

Next job will be to define colors recommended by the standard. This is being left to a subcommittee which is already at work. This subcommittee is chairmanned by Harry J. Keegan of the National Bureau of Standards. It is important because of the incidence of color blindness.

Neither the War Department nor industry intends that color markings should become a substitute for adequate guards or other safety measures, but to supplement them. In fact, a warning is written into the standard that "the marking of a physical hazard by a standard color warning should never be accepted as a substitute for the complete elimination of the hazard wherever this is possible."

New Agricultural Award Announced by Lincoln Foundation

ANNOUNCEMENT of a $37,500 award program to encourage investigation, study, and scientific development of arc welding in farm operation and maintenance has been made by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

The awards will be made for papers describing the application of arc welding to maintenance of farm equipment, machinery, or farm structures, including the construction of miscellaneous parts and contrivances. In the treatment of this topic consideration should be given to such factors as: Procedures, methods, materials, electrodes, etc., as well as economies of welding, such as savings in both time and money, or in any other pertinent factor; type of welding equipment best adapted with suggestions for new equipment and accessories; any factors dealing with the learning of welding.

There are 131 cash awards in each of two divisions. The program offers a total of $30,000 in cash awards, and $7500 in scholarships for the colleges of agriculture in the states in which the award winners reside.

Further details of "The $37,000 Agricultural Award and Scholarship Program," which closes June 15, 1946, may be obtained by writing to the secretary of The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

A.S.T.E. Elects Officers

THE Thirteenth Annual Meeting of the American Society of Tool Engineers, held in Detroit, March 23–24, 1945, resulted in the election of the following officers of the Society during the next twelve months: president, C. V. Briner, manager, gage and tool division, Pipe Machinery Company, Clevelaud, Ohio; first vice-president, A. M. Sargent, president and general manager, Pioneer Engineering and Manufacturing, Co., Detroit, Mich.; second vice-president, W. B. Peirce, vice-president, research and development, Flannery Bolt Company, Bridgeville, Pa.; third vice-president, Thomas P. Orchard, partner and general manager, American Tool Engineering Company, New York, N. Y.; secretary, A. M. Schmit, general manager, A. M. Schmit Company, Toledo, Ohio; treasurer, W. J. Frederick, president, Frederick Steel Company, Cincinnati, Ohio; assistant secretary-treasurer, W. A. Dawson, chief master mechanic, The DeHaviland Aircraft of Canada, Ltd., Toronto, Ont., Can.

The present membership is 17,918, an increase of 2498 in the last year. Of these, 1173 are serving with the Armed Forces of the United Nations.

Princeton Institutes Plastics Program

INSTITUTION by Princeton University of a program of instruction and research in plastics which will be conducted jointly by five scientific departments has been announced. The program has the twofold purpose of meeting "the growing demand in industry for men equipped with scientific or engineering training supplemented by a comprehensive background in plastics" and of conducting fundamental research in plastics and their application.

Sponsored by the School of Engineering, the program is a co-operative enterprise of the departments of mechanical, chemical, and electrical engineering, and of chemistry and physics.

The program is being developed with the assistance of an advisory committee of sixteen industrialists headed by George K. Scribner, president of the Boonton (N. J.) Molding Company. Industrial concerns are also lending support to the enterprise through the donation of equipment for the newly converted plastics laboratory building and the gift of funds.

Prof. Louis F. Rahm, of the department of mechanical engineering, is chairman of the inter-departmental committee charged with the conduct of the program. Other members of this are Dean Condit and the chairmen of the other co-operating departments, Prof. Hugh S. Taylor, chemistry, dean-designate of the Graduate School, Henry DeW. Smyth, physics, Joseph C. Elgin, chemical engineering, and Clodius H. Willis, electrical engineering.

Local Sections

Dr. Lillian M. Gilbreth Speaks at Birmingham Section

On April 17 at the Tutwiler Hotel, Birmingham, Ala., the Section heard Dr. Lillian M. Gilbreth, member A.S.M.E., consulting engineer, Montclair, N. J., and professor of management, Purdue University, speak on "The Engineers' Responsibility for the Disabled." The audience totaled over 400, and everyone was extremely interested in Mrs. Gilbreth's excellent talk. A discussion period followed.

"Flow of Coal in Chutes" Subject at Boston Section

At the April 12 meeting at Northwestern University, Boston, Mass., E. F. Wolfe and H. L. von Hohenleiten presented the results of a series of experiments on the flow of coal in chutes, in which they determined the factors governing the "sticking" and "hanging up" of coal. The effect of changes in the form of the chutes was considered in detail. Many slides and charts were presented to illustrate the changes. Ninety-five members and guests heard this excellent paper.

Talk on High-Speed Milling at Bridgeport Section

Paul Duboscl ard, member A.S.M.E., president, Paragon Research, Inc., Buffalo, N. Y., spoke on "High-Speed Milling" at the April 12 meeting in the Hotel Barnum, Bridgeport, Conn. This outstanding speaker held his audience intent as he gave an exhaustive survey of the progress made to attain high-speed milling, and with speeds almost fantastic but real. The talk and question period following consumed about three hours because of the great interest shown by the audience.

Central Illinois Section Hears President Bailey

Alex D. Bailey, president A.S.M.E., was the guest speaker at the April 12 meeting at the Peoria Country Club, Peoria, Ill. Mr. Bailey's subject was "What the Engineers Are Doing" and ninety members and guests enjoyed his talk in which he explained the various activities of the Society and emphasized the importance of student chapters. He commended the Section on their balanced budget. The following were elected for the coming year: R. S. Stainton, chairman; W. F. Bibbs, R. E. McClain, and C. W. Ham, vice-chairmen; B. R. Miller, secretary-treasurer.

Chicago Section Hears of Plans on Government Surplus Materials

At the April 13 meeting at the Hamilton Hotel, the speaker was Charles J. Clark, manager of pump and condenser department, Chicago division, Ingersoll-Rand Company, whose subject was "Modern Condenser Practice." Current practice in design and selection of condensers was described and illustrated by slides. The material covered power condensers primarily but included reference to process systems as well. Interesting cases of unusual problems of maintenance and operation were discussed, and also the importance of clean condenser tubes and elimination of air leaks.

"Disposal of Government Surplus Material" was discussed by Lieut. Col. Wm. L. Hallahan, Corps of Engineers, and P. I. Bukowski, Reconstruction Finance Corporation, at the April 23 meeting at the Hamilton Hotel, Chicago, Ill. They told of the procedures to be used by the Army and the Reconstruction Finance Corporation in disposing of the vast quantities of material and equipment ranging from airplanes to domestic plumbing and heating supplies. This problem, they said, will profoundly affect the entire setup of our industrial economy and will be solved only by close co-operation between industry and the Government disposal agencies.

On May 2 the Applied Mechanics division of the Section held a joint dinner meeting with the Mechanics Colloquium, Illinois Institute of Technology. This was the first meeting of the newly organized applied mechanics division, of the Section and was a great success, the attendance totaling 190. F. C. Rushing, member A.S.M.E., of the research laboratories, Westinghouse Electric Corporation, East Pittsburgh, Pa., spoke on "Vibration and Balancing Problems," presenting simple versions of the fundamentals of several branches of the subject.

Colorado Section Has Silver Anniversary Program

On April 26 at the Oxford hotel, Denver, Colo., the Section celebrated its twenty-fifth anniversary. At this meeting, designated as ladies' night, dinner was served to 78. Thomas B. Stearns, a member since 1883, gave a short sketch of humorous incidents about famous people, many of whom were active in the affairs of the Society. R. F. Throne next gave a short history of the Section, and Frank Prouty presented a brief résumé of the problems and aims of the Society for the future betterment of the engineering profession. The speaker of the evening was W. H. Sagstetter, chief mechanical officer of the D.&R.G.W. Railroad, whose subject "Present and Postwar Transportation on the Railroad" gave a vivid picture of the position of the railroad in service to the nation today, and the service to be rendered after the war. He illustrated his talk with colored drawings prepared by the Budd Company.

Detroit Section Hears How Electronics Serve Engineering

"Electronics at Work," a panel discussion by W. B. Montague, A. Paulus, and H. L. Lindstrom, was the feature of the May 1 meeting at E.S.D. auditorium, Detroit, Mich. These three engineers from the Westinghouse Electric Corporation discussed, illustrated, and demonstrated how electronics are made to serve engineers and engineering. One hundred and seventy-five members and guests were in attendance.

Detroit Junior Section Hears R. K. Weldy

"Inside the Diesel Engine," an illustrated talk on the problems of fuel injection, was given by R. K. Weldy, junior member A.S.-M.E., test engineer, Diesel division, Ex-Cell-O Corporation, at the meeting on April 17 at Detroit, Mich.

East Tennessee Section Hears Dr. Gilbreth

Dr. Lillian M. Gilbreth, member A.S.M.E., president of Gilbreth, Inc., Montclair, N. J., and professor of management, Purdue University, was the speaker at the April 19 meeting at Ferris Hall, University of Tennessee, Knoxville, Tenn. Her subject, "The Engineer's Part in Solving Today's Management Problems," was of great interest to members and guests.

On May 3 at the S&W Cafeteria, Eugene W. O'Brien, past vice-president, A.S.M.E., and vice-president W. R. C. Smith Publishing Company, Atlanta, Ga., spoke on the subject of "Opportunities Lie About You."

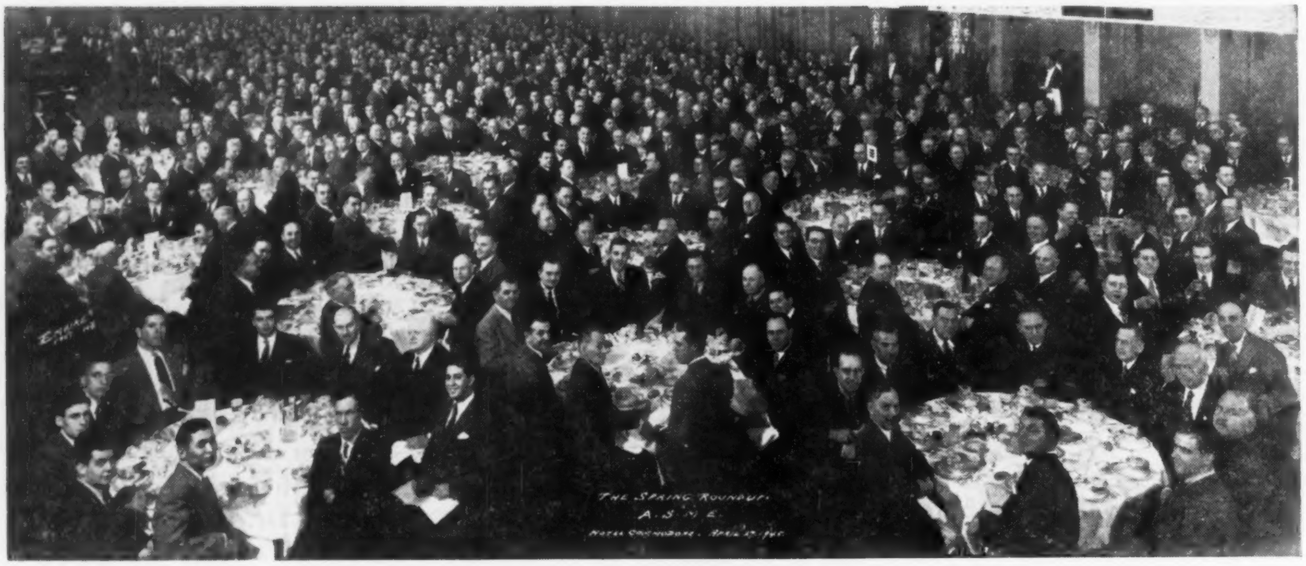
Ithaca Section and Cornell Branch Hear Captain Strok

The Section met with the Cornell Branch at West Sibley, Cornell University, on April 27, to hear Capt. M. J. Strok speak on "Engineering Experiences of a Grasshopper Pilot in the Mediterranean Theater." Captain Strok has been serving under General Clark, in charge of the service of artillery observation with Piper Cubs in North Africa and Italy. His many experiences in the development of this service and his contacts with various prominent people whom he has flown on observation trips made an unusually interesting talk.

A.S.M.E. National Nominations

The 1945 Nominating Committee invites Members to appear at its open meeting June 18, 1945, at the Hotel Stevens, Chicago. Members may present their views concerning candidates for the offices of President, Regional Vice-President, or Delegate at Large, any time between the hours 10 a.m. to 12 noon, or 2 p.m. to 4 p.m.

This year the Committee is proceeding on the assumption that the proposed reorganization of Council will be approved. Specific instructions have been sent to all Local Section Executive Committee chairmen and secretaries.



THE SPRING ROUND-UP, METROPOLITAN SECTION, APRIL 27

Louisville Section Hears Talk on Automatic Control

"Some Practical Aspects of Automatic Control" was the subject discussed by W. H. Steinkamp of the Brown Instrument Company, Philadelphia, Pa., at the March 15 meeting in the Speed auditorium, Louisville, Ky. Mr. Steinkamp gave a qualitative description of the various factors to be considered in designing equipment for automatic controls, described the general types of equipment available, and explained which type was applicable in various installations.

"A Study of Stoker Fuel Beds" by Otto de Lorenzi, member A.S.M.E., of the Combustion Engineering Company, Inc., New York, N. Y., was the subject at the April 18 meeting held in the Speed School auditorium, Louisville, Ky. Mr. de Lorenzi presented excellent color motion pictures showing the action of coal burning on various stokers, at accelerated speed, and with ultraslow motion, the effect of steam and air jets on the burning gases.

Metropolitan Section Enjoys Spring Round-Up

The annual Spring Round-Up of the Metropolitan Section of the A.S.M.E. was held on April 27 at the Hotel Commodore, New York, N. Y.

True to form, this annual get-together of the Section for dinner and an evening of entertainment proved itself one of the most popular gatherings of the year. A good dinner, fine music, and ten or more acts by outstanding entertainers made for real relaxation. After a winter of many technical meetings and excellent speakers, it was a distinct change of tempo but a welcome start for the less arduous summer program.

Mid-Continent Section Elects Officers

At the meeting of April 19 the following officers were elected for the year 1945–1946: Orval Lewis, chairman; Gwynne Raymond, Vincent J. Walker, L. Wood Jackson, and James T. Carmichael, vice-chairmen; W. F. Stewart, secretary, and Carl A. Stevens, treasurer. The executive committee consists of: D. O. Barrett, D. A. Cant, R. A. Colgin, D. E. Fields, D. E. Foster, C. O. Glasgow, J. D. Jones, W. S. Sherman, and H. G. Thuesen. New officers will assume their duties in July.

New Haven Section Meets With Bridgeport Section, American Welding Society

A joint meeting was held on April 11 at Mason laboratory, New Haven, Conn., with the Bridgeport Section of the American Welding Society, when Prof. Henry Lepper of Yale University was the speaker. Professor Lepper defined his subject "Stresses," and outlined their occurrence under various loadings and peculiarities of design. He also showed where they can be used advantageously. In welding, he pointed out their presence resulting from the localized heating and explained how they may be avoided.

William Sangster Receives Gold Membership Badge at Ontario Section Meeting

At the April 12 meeting at Hart House, University of Toronto, Toronto, Ont., Can., a special feature was the presentation to William Sangster, of DeLaval Company, Ltd.,

EXECUTIVE COMMITTEE, ONTARIO SECTION A.S.M.E.

(*Standing, left to right*: C. E. Beynon, K. D. Leitch, James McKenzie, H. H. Angus, R. C. Wiren, W. R. Trusler, *Seated, left to right*: W. H. Hewitt, F. Truman, A. L. Scott, and S. G. Clark. *Absent*, L. J. Clayton, J. G. Hall, J. W. Galloway, S. J. Liddington, W. D. Sheldon, Jr., and A. D. Smith.)

PRESENTATION OF 50-YEAR GOLD BADGE TO WILLIAM SANGSTER BY PROF. R. W. ANGUS, ONTARIO SECTION A.S.M.E., APRIL 12, 1945

Peterborough, Ont., Can., of a gold membership badge in recognition of his having completed fifty years as a member of the A.S.M.E. Mr. Sangster, who was born in Aberdeen, Scotland, in 1868, was taken to Canada in 1870, and educated in the Sherbrooke, Quebec, schools and at the Academy. He studied mechanical drawing in the provincial night school. He came to the United States in 1889 and continued his work for many years, but returned to Canada in 1913 to become associated with the DeLaval Company, Ltd.

The speaker of the evening was W. A. Osbourne, B.A.Sc., vice-president and general manager of Babcock-Wilcox & Goldie-McCulloch, Ltd., of Galt, Ont., Can. Mr. Osbourne's subject was "Trends in Steam Boiler Development."

Philadelphia Section Has Talk on Turbines and Jet Propulsion

Dr. Rupen Eksergian, fellow A.S.M.E., was the featured speaker at the meeting on April 24, at the Engineers' club, Philadelphia, Pa. His talk, heard by 315 members and guests, was entitled "Some New Applications of Turbines and Jet Propulsion."

Plainfield Section Holds Last Meeting of Season

On April 18 the Section held its last meeting of the season at the Park Hotel, Plainfield, N. J., when the speaker was John R. Bergan, Eastern Seaboard Moduflow zone supervisor for the Minneapolis Honeywell Regulator Company. In his lecture entitled "The Moduflow System of Domestic Heating Temperature Control," Mr. Bergan outlined the application of the Moduflow method of temperature control and illustrated with a sound slide film produced by the Jam Handy organization which gave a complete story on Moduflow. In the better homes of tomorrow the "on and off" intermittent system of heat supply will be obsoleted by a "modulated flow." This is the same principle of continuous flow which has been applied over a period of many years to large structures but has now been adapted to domestic heating. Seventy-five members and guests were present.

R. H. Porterfield Speaker at Providence Section

"The Big-Inch Pipe Line" was the subject discussed by R. H. Porterfield of Allis-Chalmers Manufacturing Company, at the April 3 meeting held at the Providence Engineering Society, Providence, R. I. Mr. Porterfield gave a detailed description of the construction of the pipe line itself, as well as the pressures and friction losses involved in transporting oil, and illustrated his talk with slides showing details of installing the pipe line and the pumping apparatus for transporting oil and gasoline from Texas to metropolitan New York and Philadelphia, Pa.

On May 1 the annual meeting was held to elect officers for the coming year. At the close of the election a film entitled "Rhapsody in Speed," was shown by A. C. Dickerman of the U. S. Electrical Motors, Inc. This film illustrated the variable-speed drives using motors of various sizes and also included a pictorial description of manufacturing methods.

Raleigh Section Has Talk on Brazil

"Coastal Cities of Brazil" was the featured talk at the April 20 meeting at Harvey's cafeteria, Durham, N. C., when Dr. H. C. Baity, professor of sanitary engineering, who has recently spent two years in Brazil on a mission for the Government, told of the architecture of that country, its water-purification plants, the sewage disposal, and general commerce of its coastal cities. The talk was illustrated with lantern slides and was considered excellent by an attentive audience.

Sales in Postwar America Topic at Rock River Valley Section

Capt. A. A. Nichoson, world-war veteran, and assistant to the vice-president, Texas Oil Company, New York, N. Y., spoke on "Sales

CAPT. A. A. NICHOSON

in Postwar America" at the April 6 meeting at the Nelson Hotel, Rockford, Ill. For the last seven years Capt. Nichoson, a speaker of nation-wide reputation, has addressed large audiences of executives and professional men and women throughout the country. He has talked on preserving the American way of life to industrial, trade, and professional groups, civic and service clubs, and at high schools and colleges. At this meeting he dwelt particularly on the advantages of maintaining private enterprise free from governmental restrictions and regulations.

Joint Meeting of St. Joseph Valley and Chicago Sections

On March 23 at the Gary Hotel, Gary, Ind., the St. Joseph Valley and Chicago Sections held a joint dinner meeting, when H. A. Wagner, chairman, National Mediation Committee of American Association of Engineers, and consulting engineer and co-author of the book "Technologists' Stake in the Wagner Act," was the speaker. In presenting his subject, "The Wagner Act and the Engineer," Mr. Wagner described the act from the engineer's viewpoint, emphasizing that social legislation will affect the engineer a great deal more in the future than it has in the past. He cited pending decisions of the National Labor Relations Board, since rendered, which will tend to force more engineers into collective-bargaining groups. The activities of the Founders' Societies in this problem of engineers' welfare was reviewed. In referring to the manual "Technologists' Stake in the Wagner Act" of which he is co-author, he emphasized the fact that it is the only book of its kind setting forth facts and findings of utmost importance to engineers.

J. E. Davenport Speaks at Schenectady Section

"Tomorrow's Locomotives" was the subject at the April 5 meeting held at the Van Curler Hotel, Schenectady, N. Y. J. E. Davenport, member A.S.M.E., vice-president in charge of engineering, American Locomotive Company, was the speaker, and in his talk he reviewed the advantages and disadvantages of the various modern types of motive power, steam, Diesel-electric, and electric, and discussed their future possibilities and probable lines of improvement, with improvement of the steam-turbine and gas-turbine locomotives. A general discussion followed Mr. Davenport's speech. Two hundred and fifty attended.

"Dust Collection" Talk at Virginia Section

At the March 30 meeting held in Richmond, Va., the speaker was John T. Doyle of the Thermax Engineering Company. Mr. Doyle discussed the cinder collecting fan and described its development into a cyclone and multicyclone design of collector, and its effect in industrial districts. The talk was illustrated with slides.

Col. C. E. Davies Speaks at Washington, D. C., Section

"Army Ordnance Development Since World War I" was the subject at the April 12 meeting held in the P.E.P. Company auditorium, Washington, D. C., when Col. C. E. Davies,

secretary A.S.M.E., outlined the development of the Ordnance Department, as well as the development of actual articles of ordnance. Slides illustrating the latest in rifles, carbines, antiaircraft guns, machine guns, howitzers, mobile guns, and tanks of bazookas were shown. The second part of the program featured the first showing of a film "Firepower Pays Off," which illustrated the various articles of ordnance under actual combat. Seventy-five members and guests attended.

Herbert Ziebolz Speaker at West Virginia Section

The meeting on March 27 at the Daniel Boone Hotel, Charleston, W. Va., featured a talk entitled "Electronics From a Mechanical Engineer's Viewpoint" by Herbert Ziebolz, junior member A.S.M.E., and power engineer, E. I. du Pont de Nemours Powder Co., Wilmington, Del. By the use of fundamental concepts Mr. Ziebolz showed how design trends are developed into more or less definite rules whereby the engineer may attempt to foretell what the future design should be. By carrying these ideas into electronics, he showed how electronic circuits and equipment could be applied and used in developing new designs for industrial instruments. A remarkable number of basic ideas were considered to illustrate the possible application of electronics. The able use of the hydraulic analogy made the unfamiliar characteristics of electronic circuits easier to understand.

"Industrial Electronics" Subject at Western Washington Section

"Industrial Electronics and Postwar Electronic Possibilities" were discussed by Frank P. Barnes, chief electronics engineer, Western division, General Electric Company, at the meeting on April 19 at the Engineers' Club, Seattle, Wash. He discussed some recent applications of electronics for the control of industrial processes and explained the present state of development of television and the possibilities of postwar use.

Student Branches

University of Alabama Branch

"Tornado in a Box" a movie on turbines, was the feature of the Feb. 20 meeting. Following the showing of the film, B. H. Standley gave a very interesting talk on why he left a well-paying job to return to college.

University of California Branch

The first meeting of the spring term was held in the engineering building on March 23. Mr. Harry Kennedy, a graduate of the University of California and inventor of the Union melt welding process, was the guest speaker. Mr. Kennedy spoke on "Welded Ships and Other Structures and Some Causes of Their Failure," and a general discussion followed his interesting talk. He is now engaged in research on welding in the engineering-materials laboratory of the University.

On April 20 a meeting was held in the engineering building, when new members were welcomed. The feature of the meeting was a film, "Tornado in a Box," dealing with gas turbines, shown by Prof. R. G. Folsom. An informal discussion on gas turbines and jet-propelled airplanes followed.

University of Cincinnati Branch

A meeting was held on April 4 at the Students' Union building when plans were made for an exhibit on pre-freshman day. Members volunteered to act as guides through the mechanical engineering laboratory and to run engines for the pre-freshmen.

Two motion pictures were shown at the meeting on April 11; the first on flame cutting, and the second on welding.

University of Idaho Branch

On March 27 an inspection trip was made to the Lewiston, Idaho, saw mills and plant of the Potlatch Forests, Inc., the Lewiston plant of the Washington Power Company, and the W.W.P. substation at Clarkston, Wash., as well as the Lewiston Gas Plant.

An exhibition of aluminum casting was the feature presented by the Branch at the Associated Engineers' annual laboratory party on April 6. After a brief explanation of the procedure, molds were made and castings poured and made into souvenirs for the guests.

Illinois Institute of Technology Branch Holds Two Meetings

Prof. John I. Yellott, member A.S.M.E., director of the Institute of Gas Technology, spoke on "Jet Propulsion" at the March 28 meeting at the Students' Union building. His talk included the historical background and the present and future ideas on jet propulsion.

At the April 20 meeting in the main building, the guest speaker was T. S. McEwan, vice-president A.S.M.E. Mr. McEwan gave a very interesting paper on "Engineering During the War," its purpose being to show how effectively engineering has increased war production quality and quantity. Program cards were distributed to Navy students so that arrangements could be made for their attendance at the Northwestern Conference.

Iowa State College Branch

The first meeting of the spring semester was held on March 15 at Engineering Hall, in co-operation with the other engineering student branches on the campus. Paul S. Clapp, 1913, spoke of his experiences as a young engineer helping to build the first transcontinental telephone line. The chief topic of his talk, however, dealt with facts and advances in the field of public utilities, especially private production of electricity.

On March 29 a meeting was held at Memorial Union, when Stephen Shea was nominated to represent the Branch in the Engineering Council. Prof. R. E. Rouderbush gave a talk on some Virginia coal-loading apparatus illustrating his talk with slides.

Lafayette Branch Meets With A.I.E.E.

A joint meeting with the student branch of A.I.E.E. was held on April 26 at Pardee Hall, when an Allis-Chalmers motion picture "Tornado in a Box" was shown. This film is an outstanding exposition of the gas turbine. Prof. E. M. Fernald, of the mechanical-engineering department, then delivered a short address on the gas turbine, and at its conclusion the meeting was thrown open to discussion.

University of Michigan Branch

The first meeting of the new semester was held on March 21 at Michigan Union, when the president welcomed regular and prospective members and gave a brief outline of the history and objectives of the A.S.M.E. Professor Schwartz, faculty honorary chairman, was introduced. Various committees were formed and suggestions made regarding future programs.

At the April 4 meeting the speaker was T. E. Winkler, junior member A.S.M.E., of the Detroit, Mich., department of public works. Mr. Winkler explained the several methods of waste disposal in current use in Detroit and other large cities. He cited many of the difficulties involved and indicated improvements which may be expected in the future. A question period followed his talk.

Northeastern University Branch

The April 17 meeting featured a talk by Malvin M. Yurko of the senior class on the development and performance of the gas turbine. He pointed out that although the gas-turbine principle has been known for centuries, it was not until the last decade that improvements in metals made its operation economically feasible. Mr. Yurko then gave a description of some of the apparatus used to increase the efficiency of the basic unit.

"Refrigeration" was the subject on which Prof. Alfred J. Ferretti, mechanical-engineering department, spoke at the meeting on April 24. After tracing the history of food preservation up to the present time, Professor Ferretti said that it was not until the end of the last century that people began to study mechanical refrigeration in earnest. He then described the refrigerating cycle and defined some of the terms peculiar to the field.

At the May 1 meeting Thomas W. F. Chin of the senior class spoke on the manufacture of a carbine trigger. Mr. Chin described the sequence of thirty-four processes and twenty-four inspections that go into the manufacture of the part. He illustrated his talk with models and sketches.

Oregon State College Branch

At the first meeting of the term, Jan. 17, the following were elected to office: Thomas Feazel, chairman; Leon Lipschitz, vice-chairman; Eric Mohr, secretary; Richard Slattery, treasurer, and Roland Ott, sergeant-at-arms. An interesting talk was given on geo-politics by Prof. Clifford Maser, head of the department of business and industry of the College.

On Feb. 14 two films were shown, "The Coast Guard in Action," and "Alloy Steels," the latter furnished by the Climax Corporation.

Prof. Edwin T. Hodge of the economic geology department spoke to the members at the Feb. 28 meeting on "The Location of Dam Sites." Professor Hodge was a consultant on the location of the Bonneville Dam.

On March 7 a film entitled "Gun Control on Big Bombers" was the feature.

Two field trips were made during the term; the first, Feb. 17–18, to the Aluminum Company of America, Vancouver, Wash., Electric Steel Foundry, Portland, and Station El, Portland, Ore. The second trip was made on March 10 to the watershed of the city of Corvallis, Ore., and a sight-seeing and skiing trip to a near-by mountain.

Pennsylvania State College Branch

At the April 12 meeting in engineering building "D" the following officers were elected: John Zoszak, president; Marvin Breslaw, vice-president; and Elizabeth Griffith, secretary. The newly-elected president then appointed a program committee and a publicity committee. The use of films for future meetings was discussed, and plans made for arousing the interest of other students in the organizaion.

The latest film of Allis-Chalmers Company was shown at the April 26 meeting held in the electrical-engineering building. This film was "Tornado in a Box" and was followed by another film, "Diesel, the Modern Power." These two pictures covered the fundamental aspects of the gas turbine and the Diesel engine.

Purdue University Branch

At the April 26 meeting held in the Golden Shops, the Detrex Corporation of Detroit, Mich., demonstrated its system for degreasing of machinery and equipment. Several representatives of the Detrex Corporation were present to answer questions concerning industrial cleaning problems. The audience consisted of Purdue students, professors, and local manufacturers. A paper was read, accompanied by illustrative slides explaining electrolytic and alkaline cleaning systems. Then several sound slides were shown illustrating the installation, use, and maintenance of the wash-spray-vapor system of degreasing. Machines for small parts and small-scale manufacturing were seen, as well as those for large parts and for straight-line flow production in conveyerized units. These machines consisted of solvent reservoirs, heating coils, condensers, etc. A small machine of this type was put into operation where the audience could actually observe the system degreasing soiled parts.

Polytechnic Institute of Brooklyn Branch

The first meeting of the Spring term was held on April 10, when the speaker was A. L. Nicolai of the Combustion Engineering Company. Mr. Nicolai spoke first of how to apply our knowledge learned in school to problems in the field of engineering. He then showed problems involved in a power plant by the use of a diagram. He explained different types of boilers, with the aid of slides, and emphasized the sizes and fuel consumption of these boilers. He concluded with a résumé of the importance of the theory learned at school.

A second meeting was held on April 17 with the A.S.C.E. The speaker was Robert M. McGee of Pittsburgh, Pa., whose subject was "Production of Iron and Steel." After giving some statistics of the steel industry, he explained the production of iron and steel with the aid of a film. The film included the mining of the iron ore, the blast furnace, the Bessemer process, and the open-hearth process. Mr. McGee also explained the chemical reactions involved in the production of iron and steel.

After three years, the Evening-Session Branch was reorganized at the Institute on April 12, and the following officers elected for the current semester: Prof. E. F. Church, Jr., honorary chairman; Irving Handelman, chairman; William Schertzer, vice-chairman; Joseph P. DeRosa, secretary; Rudy P. Luttkus, treasurer. Professor Church gave an interesting talk on the purpose and benefits of joining a technical society when one is young, and also stressed the necessity of co-operation of the members with the officers to make any organization a success. Chairman Handelman gave a talk on the future plans of the Branch. On April 19 another meeting was held, when R. H. Fleming, C. Hoglund, and A. Heller were appointed for the program committee. A discussion was held on the advisability of having inspection trips, and membership cards were distributed.

Pratt Institute Branch

R. Tom Sawyer, member A.S.M.E., of the American Locomotive Company, New York, N. Y., was the speaker at the March 27 meeting. His illustrated lecture "Turbocharging and the Fundamentals of the Gas Turbine," was most interesting and evoked a spirited discussion. Mr. Sawyer is the author of a recent book entitled "The Modern Gas Turbine."

Queen's University Branch

On Jan. 11 thirty-five members of the Branch made a trip to the Reliance Aircraft Company's plant at Belleville, Ont., Can. The various departments were inspected—engineering offices, machine, woodworking, and welding shops, assembling, painting, and shipping departments. The company makes tail assemblies, ammunition boxes, and chutes and other parts for one of the Canadian-built bombers. Some of these parts are shipped directly overseas as replacement parts, and the methods of export packing were of special interest. A few weeks later a trip was made to the Aluminum Plant of Canada, at Kingston.

The annual banquet of the Branch was held on April 23 at the Students' Union. Major General E. J. C. Schmidlin, honorary chairman of the Branch, gave a most interesting talk in the form of a farewell to the graduating students. He announced that he would remain at the University as head of the mechanical-engineering department for another year. His speech was followed by a brief talk by Prof. W. A. Wolfe, who was formerly honorary chairman of the Branch since its founding in 1942. Professor Wolfe gave a history of the Branch and its accomplishments.

Rice Institute Branch

New officers for the coming term were elected at the April 9 meeting as follows: G. E. Allison, chairman; C. M. Smith, vice-chairman; G. B. Scarborough, secretary, and J. D. Humble, treasurer. Plans were made for inspection of various industrial plants in the vicinity of Houston, Texas.

Yale Branch

The first organization meeting of the spring term was held on March 7, when John Prisloe was elected chairman, and Arthur Berger secretary-treasurer. Seven new members were welcomed: Arthur Berger, R. B. Dowdell, R. C. Erhardt, J. J. Gallow, F. G. Griswold, E. G. Mudarri, and R. C. Tucker.

At the March 14 meeting speeches were given by members, including "Jet Propulsion," by T. H. Burbank; "Relaxation," by R. P. Carroll; "Do or Die Devils of Japan," by R. P. Godwin; "Freedom of the Press," by C. P. Lee, and "Pigeon English," by E. F. Mioduszewski.

On March 21 W. M. Braithwaite spoke on "Mechanics of the Newspaper;" R. B. Dowdell on "Progress in Chicken Farming;" J. J. Gallow, "At a Loss for Words;" Schultz, "Juvenile Delinquency;" and R. C. Tucker, "The RH Factor."

On April 3rd the members heard "The Business Behind Photography," by Arthur Berger; "Color is Power," by G. J. Crowley; "World Calendar Reform," by F. G. Griswald; "The Engineering Societies Library," by Merrill Holpert; and "Epilepsy," by C. W. Spangle.

A.S.H.V.E. Laboratory Studies Air Duct Friction

THE subject of air duct friction will be a major study at the Research Laboratory of the American Society of Heating & Ventilating Engineers, Cleveland, Ohio, under the direction of the Technical Advisory Committee on Air Distribution and Air Friction.

The committee consists of Ernest Szekely, chairman, Milwaukee, Wis.; S. H. Downs, Kalamazoo, Mich.; S. L. Elmer, Jr., Syracuse, N. Y.; K. H. Flint, Cleveland, Ohio; W. H. Hoppman, Jr., Brooklyn, N. Y.; F. J. Kurth, New York, N. Y.; J. H. Livermore, Detroit, Mich.; D. J. Luty, Detroit, Mich.; R. D. Madison, Buffalo, N. Y.; Prof. L. G. Miller, E. Lansing, Mich.; Prof. D. W. Nelson, Madison, Wis.; Prof. G. B. Priester, Cleveland, Ohio; L. P. Saunders, Lockport, N. Y.

Responsibility for these studies has been given to a subcommittee, R. D. Madison, chairman, Buffalo, N. Y.; S. H. Downs, Kalamazoo, Mich.; L. P. Saunders, Lockport, N. Y.; K. H. Flint, Cleveland, O.; H. F. Hagen, Boston, Mass.; L. L. Simmons, Detroit, Mich.; and Prof. D. K. Wright, Cleveland, Ohio, and a conference was held April 5 at the research laboratory. A report on the following aspects of the subject of air duct friction prepared by Professor Wright for the Committee on Research, was considered: (*a*) A comparison of basic source data; and (*b*) a comparison of the present friction chart in the "Guide" with similar charts or tables in use by various organizations or recommended in handbooks and textbooks.

In presenting his report, Professor Wright stated, "Authorities in the field of fluid mechanics are in essential agreement as to the general equations governing the friction of fluid flowing in closed round pipes. These relations have been employed by Rouse and by Moody in preparing charts from which the friction coefficient can be determined. It has been definitely established that these charts are valid for a large number of fluids, air among them. Since any practicable setup for testing

the friction of ventilating ducts is limited as to sizes of ducts which can be tested, and velocities which can be reached, such tests as were made in the past have been generally restricted to conditions in the lower portion of the friction chart. This limited range of results leads to an equation which can be greatly in error if extrapolated sufficiently to include the range of the usual friction chart."

It was pointed out that the friction charts now in general use tend:

(1) To give friction values too low in the upper range if satisfactory in the low range, or too high in the middle if satisfactory at top and bottom.

(2) To overemphasize the effect of change of diameter in the low-velocity range.

(3) To underemphasize the effect of change of diameter in the high-velocity range.

Six of the members of the subcommittee met with Prof. G. L. Tuve, chairman of the Committee on Research, and members of the staff of the laboratory at this conference and took part in a discussion on Professor Wright's report and the whole subject of air-duct friction. The following conclusions were drawn:

(1) The committee accepted the report and recommended that the study be continued and a tentative friction chart prepared based on Moody's work, published in November, 1944, in the Transactions of A.S.M.E. using a value of 0.0005 ft for the roughness parameter. This tentative chart is to cover round pipe only, with workmanship and interior smoothness defined.

(2) A paper will be prepared for presentation through the Technical Advisory Committee on Air Distribution and Air Friction and publication in the Journal Section of *Heating, Piping and Air Conditioning*. The committee hope that the material in the paper will subsequently prove to be of value for textual material in the 1946 issue of the "Guide."

(3) It was the consensus of opinion that for the present it would be satisfactory to follow the old practice of equivalent rectangular ducts based on the mean hydraulic radius, but it was recommended that a project be set up at the laboratory as soon as possible to verify, by test, the actual relationship for ducts having an aspect ratio from 1 to 1 to 1 to 6.

(4) It was also recommended that a study be undertaken on losses in elbows, fittings, and transformations, the first step being to collect data already available from various sources in the literature, including that developed by the Brooklyn Navy Yard and the N.A.C.A. The committee recommended that in addition to a search of the literature, test work be undertaken at the A.S.H.V.E. research laboratory.

I.I.T. Sets Up Corrosion Research Laboratory

THE Illinois Institute of Technology has announced the establishment of a corrosion research laboratory under the direction of Dr. Hugh McDonald.

The laboratory will conduct a basic long-range research program on the fundamental theory of the mechanism of corrosion processes and control and will serve as a center for graduate instruction in corrosion.

E.I.C. Institute Rehabilitation and Personnel Services

MAJOR Donald C. MacCallum, a veteran of the Italy campaign, recently discharged from the Army because of wounds, has been appointed to direct the rehabilitation and personnel services of The Engineering Institute of Canada.

The expanded activities of the Institute in this field will be directed by an advisory committee headed by Major General Howard Kennedy, of Montreal, former Quartermaster-General, and upon which there are representatives of all three services and industry and government.

Major MacCallum will be located at the headquarters of the Institute, 2050 Mansfield St., Montreal 2, Quebec.

A.S.A. Standard for Oils and Greases

UNSKILLED labor can be effectively guided in applying the right grease or oil to machinery through use of a new American War Standard based on a simple system of matching colors.

This war standard has been developed through the American Standards Association at the request of the National Machine Tool Builders Association and the War Production Board. The purpose is to facilitate the lubrication service of machinery and also to cut down the increasing amount of damage to machinery in war plants from misuse of lubricants by unskilled labor.

M. A. Mason Honored

DR. MARTIN A. MASON, chairman of the A.S.M.E. Washington Section, has received the Exceptional Civilian Service Award of the Office of Chief of Engineers, U. S. Army, for his work in selecting beach landing sites for troops.

The citation reads: "In recognition of his exceptional achievements in orginating, organizing, and supervising the preparation of confidential maps and strategic studies of foreign coastlines which have contributed immeasurably to the success of amphibious operations."

Dr. Mason is principal engineer of the Beach Erosion Board of the War Department.

Hayden Foundation Grant to Stevens Institute

A GRANT of $50,000 made by the Charles Hayden Foundation to Stevens Institute of Technology in connection with its 75th Anniversary has been announced by Dr. Harvey N. Davis, president of the College, at the spring meeting of the Board of Trustees. The gift is to be used for college purposes or "in such other way that the trustees of the College agree will be most helpful in producing quality engineers."

The Charles Hayden Foundation was established in 1938 under the terms of the will of the late Charles Hayden to realize "his cherished aim and purpose to establish a foundation whichs hall be employed in the education of boys and young men, and especially in their moral, mental, and physical well-being."

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative, nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

New York	Boston, Mass.	Chicago	Detroit	San Francisco
8 West 40th St.	4 Park St.	212 West Wacker Drive	109 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

GRADUATE MECHANICAL ENGINEER, registered professional, 34, married, ten years' experience design, application automatic control equipment in power plant, process industries, desires responsible position as project, consulting engineer. Consider foreign assignment. Me-906.

[1] All men listed hold some form of A.S.M.E. membership.

MECHANICAL ENGINEER, 31, married, experienced in steam and Diesel design, operation, and construction; desires position with utility, railroad, or large industrial organization offering opportunity for power plant, equipment, and process design. Available about August 1. Me-907.

WELDING ENGINEER, 48, married, sixteen years' experience. Control of processes through methods and procedures, jig design, tooling, development automatic electron

welding equipment, specification and purchase of equipment for economy of operation and maintenance. Redesign for welding. Available immediately. Location preferred, Pacific Coast. Me-908-441D8.

Plant Engineer, licensed professional, graduate M. E., fifteen years' general industrial experience in mechanical and process field. Now employed as chief engineer, national pharmaceutical manufacturer. Reliable, capable, progressive, young. Me-909.

POSITIONS AVAILABLE

Sales Engineer, mechanical, with some experience in sales promotion on specialties, such as flexible metal hose, etc. Man will work both inside and outside. Salary, \$5000–\$6000 a year. Location, New York metropolitan Area. W-5226.

Market Research Engineer who is experienced in the industrial phase of sales research for a company engaged in the manufacture of starch and starch products for sale to industrial concerns. Man will do the routine work of digging out from available literature and through interviews some of the information necessary for this work. Company is now engaged in a large and extensive program of sales research in connection with present products and new ones. Salary, about \$5000 a year. Location, New York, N. Y. W-5260.

Mechanical or Industrial Engineers, graduates, with two or more years of industrial experience, for motion study, production flow, and other surveys and investigations to improve methods, processes, and conditions, including the supplanting of hand methods with automatic machinery, the writing of material specifications, the planning of work layouts, etc. Apply by letter outlining education and experience and including references, together with snapshot, and draft classification. Salary open, depending upon training, etc. Location, New York State. W-5261.

Engineers. (*a*) Senior project engineer, experienced. Will sit in on all product manufacturing planning meetings, both to interpret the designers' ideas to production personnel and to protect the design by being sure planned operations will give adequate quality. Act as liaison man between production and engineering. Salary, \$5000–\$7000 a year. (*b*) Assistant director of sales, under 40. Should be conversant with the engineering involved in the application of unit heaters. Work will principally consist of sales engineering. Salary, \$4200–\$4500 a year. Location, upstate New York. W-5283.

Engineers. (*a*) Chief inspector preferably with some experience in precision parts and a knowledge of electronic tests desired. (*b*) Supervisors preferably with some experience as superintendent or plant manager in a general manufacturing plant. Salaries, \$6000 a year. Location, Connecticut. W-5286.

Mechanical Engineer, 40–45, with considerable experience in the mechanical problems involved in the production of a precision product. Must have experience in design of small tools and dies, and in the deep drawing of metal. Should be capable of taking charge of engineering and drafting department. Salary, to \$6000 a year. Location, Pennsylvania. W-5291 (*d*).

Plant Superintendent to supervise and assume complete responsibility for all assembly, machining, and maintenance operations in a plant of 450 employees. Will co-ordinate and improve methods of manufacture, confer on inspection policies, salvage operations, and handle industrial relations. Will have to establish good safety procedures and training programs. Salary, \$6500–\$7500 a year. Location, Vermont. W-5302 (*a*).

Superintendent of Production with background and experience in a woodworking plant covering such items as stock millwork, kitchen cabinets, and speciality items that are made on a production basis. Must be thoroughly experienced on woodworking machinery and lumber. Salary, \$5000–\$7000 a year. Location, Pennsylvania. W-5309 (*a*).

Engineers. (*a*) Industrial engineer experienced in time study and methods for aircraft company specializing in firewalls, manifolds, etc. Salary, \$7500 a year. (*b*) Project engineer experienced in aircraft work particularly as applied to the foregoing. Salary, \$5000–\$7000 a year. Location, Connecticut. W-5335.

Shop Superintendent with complete knowledge of machine-shop operations plus some knowledge of metal heat-treating and production control for company manufacturing sawmill machinery. Salary, \$6000 a year. Location, Tennessee. W-5361.

General Manager with considerable gray-iron foundry experience and some plate and machine-shop experience to take charge of heating-equipment plant. Salary, \$8000 a year. Location, New York, N. Y. W-5371.

Instructor or Assistant Professor of Mechanical Engineering. Salary, \$2400–\$3000 a year. Also an instructor of physical chemistry. Location, upstate New York. W-5381.

Refrigeration Engineer. Must have had at least five or ten years' experience in the design, installation, and operation of all types of refrigeration equipment. Salary, \$8000–\$10,000 a year. Location, New York, N. Y. W-5385.

Chief Engineer with experience in tool design and process engineering. Must have had some experience in light fabrication of metals, hardware, locks, door handles, etc. Salary, \$8000–\$8500 a year. Location, Pennsylvania. W-5387.

Lincoln Arc-Welding Foundation Offers \$20,000 in Awards

The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, has announced a new project known as "The \$20,000 Award Program for Textbooks Covering Machine and Structural Design for Modern Processes," eligible to any person in the teaching profession, in industry, or engaged in private consultation. The awards are divided into two classes: Class A, Machine Design; and Class B, Structural Design. There are three awards in each class. Papers will be judged by a jury of award drawn from appropriate branches and institutions of engineering education. Selection of the jury will be under the direction of the chairman of the jury of award, Dr. E. E. Dreese, The Ohio State University, Columbus, Ohio.

Further details of this new award program for textbooks, which closes May 15, 1946, may be obtained by addressing The Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Chanute Medal Awards

Frank F. Fowle, consulting engineer, Frank F. Fowle & Company, Chicago, Ill., and Robert L. Anderson, superintendent of public works, Winnetka, Ill., have been chosen to receive the Octave Chanute Medal for the year 1944 from the Western Society of Engineers. Formal presentation of the medal will be made at a later date.

The Chanute Medal is awarded to Chicago engineers for the best paper on electrical, mechanical, or civil engineering subjects presented before the society.

The Chanute award was founded in 1901 by the late Octave Chanute during his term as president of the Western Society of Engineers.

Candidates for Membership and Transfer in the A.S.M.E.

The application of each of the candidates listed below is to be voted on after May 26, 1945, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

Alcorn, Robert L., Jr., Orange, Texas
Allen, E. E., Maywood, Ill.
Baird, Robert D., West Allis, Wis.
Bell, Charles H., Westfield, N. J.
Brady, Leo J., Darien, Conn.
Bruce, A. D., Evanston, Ill.
Bryan, Edward Everett, Nashville, Tenn.
Calhoun, J. Newton, Cleveland, Ohio
Clay, James A., Jr., Fort Worth, Texas
Clement, Edward J., Hempstead, N. Y.
Corbett, Clifford W., New York, N. Y.
Costa, R. M. F., Washington, D. C.
Creager, Paul S., New Brunswick, N. J.
Dauphinais, George A., Syracuse, N. Y.
Davidson, Edward H., Jr., Washington, D. C.
Dicke, Allen A., New York, N. Y.
Drescher, Rowland B., Chicago, Ill.
Farr, Eric M., Packanack Lake, N. J.
Ferrara, Norman, New Brunswick, N. J.

FLOOR, URBAN, Rockford, Ill.
FORSTER, HANS W., Eden, N. Y.
FOY, THOMAS DOUGLAS, Schenectady, N. Y.
FRY, WINTHROP H., Bridgeport, Conn.
GOULD, GEORGE D., Roslyn, N. Y.
GRIER, A. M., Montreal, Quebec (Rt)
HALE, WILBURN, Douglaston, N. Y.
HARRISON, ERNEST BURTON, St. Joseph, Mo.
HARTMAN, ELMER C., Rochester, N. Y. (Rt & T)
HEIN, HOWARD A., Cleveland, Ohio
HEWITT, F. M., Farmington, Mich.
HORAN, FRANCIS T., Groton, Conn.
HOUSTON, MACLEAN, Warren, Pa.
HUNT, JAMES W., West Allis, Wis.
HURET, BENJAMIN D., Bronx, N. Y.
JOHNSON, DOUGLAS O., Tulsa, Okla.
JOHNSON, FLOYD F., Berkeley 3, Calif.
JOHNSON, JOHN M. (PVT.), Cynwyd, Pa.
KADZ, H. D., Glendale, Calif.
KEARNEY, WILLIAM F., Bloomfield, N. J.
KOVALEFF, SERGE P., Burlingame, Calif.
KRAHULEC, FRED, Chicago, Ill.
KRUG, GERMAN L., New York, N. Y.
LANDON, DUANE, St. Joseph, Mo.
LESSER, W. H., JR., Baltimore, Md. (Re)
LEWIN, HELLMUT L., Stamford, Conn.
LILLIBRIDGE, D. B., Kansas City, Mo.
MAXIM, W. S., Evanston, Ill.
MAYES, THORN L., Oakland, Calif.
MCCORMICK, CHARLES D., Wilmington, Del.
MCINTYRE, D. D., Thornton Heath, Surrey, England
MCKAY, WILLIAM E., New Milford, N. J.
MCLAIN, A. R., Chattanooga, Tenn.
MONRO, D. A., Chicago, Ill. (Rt)
MOSES, A. J., Chattanooga, Tenn. (Rt)
NAGLER, L. H., Detroit, Mich.
NOORDYK, LESTER JACOB, Totowa Borough, N. J.
OAKLEY, WALTER W., Corning, N. Y. (Rt)
OSGOOD, CHARLES F., Claremont, N. H.
OSTERTAG, CHARLES W., Indianapolis, Ind.
PFEFFER, GEORGE E., Sharonville, Ohio
PORITSKY, HILLEL, Schenectady, N. Y.
POYSER, STANLEY J., Seattle, Wash.
REUTER, OTTO, Palisade, N. J.
ROWBOTHAM, G. E., Montclair, N. J.
SCHIFF, HENRY, New York, N. Y.
SCHWEMLER, PAUL R. (ENS.), New York, N. Y.
SCHOOLBERG, HENRY, Gibsonia, Pa.
SETTERHOLM, VERNON M., New London, Conn.
SOIYA, GEORGE W., Cumberland, Md.
SPRIGGS, CECIL T., Malverne, N. Y.
STARY, MARVIN L., Alhambra, Calif.
STEWART, JOHN C., Webster Groves, Mo.
STRANBERG, DON F., Libertyville, Ill.
SUTHERLAND, CHARLES E., Cleveland Heights 12, Ohio
TAUL, H. W. (LIEUT. COL.), West Point, N. Y.
TRECKER, JOSEPH L., Milwaukee, Wis.
VAN BLARCOM, GILBERT F., Fall River, Mass.
VELKOBORSKY, V. G., New Orleans, La. (Rt & T)
WAGNER, FRANK CASPAR, Corpus Christi, Texas
WALSH, THOMAS B., Boston, Mass.
WANSKI, M. H., Akron, Ohio
WILLIAMS, ROBERT M., Toledo, Ohio
WILSON, EDWARD EWELL, St. Joseph, Mo.
WILSON, WARREN E., Winnetka, Ill.
WOODWARD, THOMAS F., Detroit, Mich.
WORTHINGTON, EMORY W., Chicago, Ill. (Rt & T)
YOUNG, MERRILL A., Steilacoom, Wash.
ZIMMERMAN, LLOYD M., Chicago, Ill.
ZORWITZ, JEROME, Elberon, N. J.

CHANGE OF GRADING

Transfers to Member

ADAMS, JOHN, Detroit, Mich.
ALEXANDER, BEATINA W., Elizabeth, N. J.
ASCH, ABRAHAM B., Forest Hills, N. Y.
BERGEN, MARTIN JOHN, Newark, Del.
CASSIDY, H., Montreal, Quebec, Can.
CHOWNING, JAMES R., Wilmington, Del.
CLOWER, M. G., Louisville, Ky.
CONTA, LEWIS D., Ithaca, N. Y.
CORNELL, SIDNEY, W. Hartford, Conn.
FLEMING, BURRITT G., Cincinnati, Ohio
FOWLER HENRY C., JR., Pine Orchard, Conn.
GEISINGER, JOSEPH M., Detroit, Mich.
GETSUG, BERTRAM, Pensacola, Fla.
HEAVILON, ERNEST BAKER, Cleveland, Ohio
JOYCE, REGINALD, Washington, N. J.
KINNISON, COURT, San Francisco, Calif.
MUESSEL, C. A., JR., New York, N. Y.
SCHULTZE, GEORGE W., Hopewell, Va.
SHAW, BENJAMIN F., II, Wilmington, Del.
WELLS, J. M., Detroit, Mich.

Transfers from Student-Member to Junior 43

Necrology

IT is urged that the Society be notified promptly of the deaths of members and that the date of death be given for announcement in MECHANICAL ENGINEERING. Complete memorial biographies are published in the Society Records (Section Two of Transactions), and relatives, business associates, and Society officers and members are requested to send newspaper clippings or information in any other form which will be useful in the preparation of such biographies. A special biographical data sheet for supplying complete details will be furnished by the headquarters office upon request.

ADAMS, HARRY H., January 31, 1945
BARNES, FREDERICK A., November 29, 1944
BENNS, CHARLES P., March 3, 1945
BONNER, JOSEPH C., September 28, 1944
CARPENTER, HORACE, January 4, 1945
CARTIN, JAMES D., December 16, 1944
DE FOREST, ALFRED V., April 5, 1945
GLASS, WILLIAM C., March 12, 1945
HASKELL, RAYMOND, April 6, 1945
LINCOLN, PAUL M., December 20, 1944
LOBDELL, KENNETH C., March 30, 1945*
MACINTYRE, H. D., March 15, 1945
NEAL, JOHN R. H., September 12, 1944
NEIDIG, WILLIAM N., March 7, 1945
NEILER, SAMUEL G., February 28, 1945
PARKER, ARTHUR LA RUE, January 1, 1945
PATTERSON, ARTHUR W., JR., March 5, 1945
PORTER, HOLLIS P., January 22, 1945
PURINTON, ARTHUR J., March 5, 1945
REED, FRANCIS T., January 26, 1945
SAALFRANK, JOHN M., February 3, 1944

* Died in line of duty.

VAN LAW, DURBIN, December 21, 1944
WADDELL, CHARLES E., April 20, 1945
WALDRON, WILLIAM H., February 1, 1945
WEBSTER, WILLIAM R., April 28, 1945

A.S.T.M. to Extend Activities

THE American Society for Testing Materials has announced certain extensions of its activities.

Based on the report of a committee of authorities which investigated exhaustively the various angles involved, the society is extending its standardization activities in the field of ultimate consumer goods and is appointing a new administrative committee to direct this work.

The study, development, and standardization of methods of tests of materials, parts, and assemblies in actual or simulated service condition is another phase of the work to be undertaken.

A.S.R.E. Has New Headquarters

NATIONAL headquarters offices of The American Society of Refrigerating Engineers, for the last three years located at 50 West 40th Street in New York, were moved on April 15 next door, to 40 West 40th Street, New York 18, N. Y. New furnishings have been acquired for the attractive new suite, which occupies the twelfth floor of the American Radiator Company's building.

A.S.M.E. Transactions for May, 1945

THE May, 1945, issue of the Transactions of the A.S.M.E. contains:

Influence of Applying Cutting Fluids at Different Temperatures When Turning Steel, by O. W. Boston, W. W. Gilbert, and R. E. McKee

A Thermal-Balance Method and Mechanical Investigation for Evaluating Machinability, by A. O. Schmidt, W. W. Gilbert, and O. W. Boston

An Analysis of the Milling Process, Part II—Down Milling, by M. E. Martellotti

Creep Properties of Molded Phenolic Plastics at Elevated Temperatures, by W. J. Gailus and David Telfair

Effect of Some Environmental Conditions on the Permanence of Cellulose-Acetate and Cellulose-Nitrate Sheet Plastics, by T. S. Lawton, Jr., and H. K. Nason

Properties and Development of Papreg—A High-Strength Laminated Paper Plastic, by E. C. O. Erickson and G. E. Mackin

External Corrosion of Furnace-Wall Tubes—I History and Occurrence, by W. T. Reid, R. C. Corey, and B. J. Cross

External Corrosion of Furnace-Wall Tubes—II Significance of Sulphate Deposits and Sulphur Trioxide in Corrosion Mechanism, by R. C. Corey, B. J. Cross, and W. T. Reid

Helical Taper Reamers Milled With Constant Helix Angle, by T. F. Githens

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Announcements in this section are supplied by current advertisers in MECHANICAL ENGINEERING and A.S.M.E. MECHANICAL CATALOG.

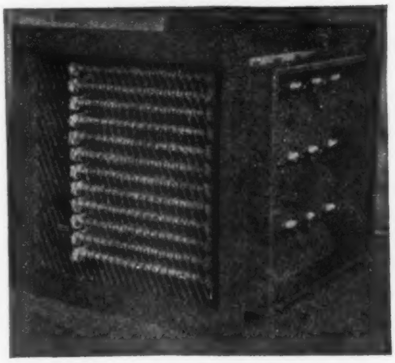
This section is restricted to these advertisers.

• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• *NEW EQUIPMENT*

Air Duct Heaters



Flanged heater sections—built to fit into air ducts of any size. Ratings from 6 K. W. up to several hundred K. W. are available for any commercial voltage, with variable heat stages to suit automatic controls. Heaters of this type are useful in special air conditioning systems, air preheaters, recirculating ovens and other industrial projects.

Hynes electric heating systems are carefully engineered to meet industrial needs and are fully guaranteed. Many other special types are available. Write for a list of notable installations to Hynes Electric Heating Co., West & Clinton Sts., Camden, N. J.

Platinum Thermocouple Assembly Changes Said to Mark Advanced Step

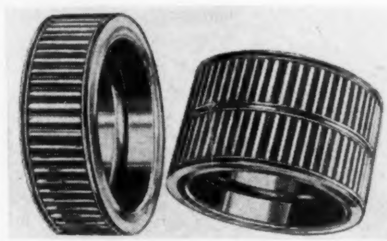
Improvements in platinum thermocouple assemblies used with two-hole silica blocks for glass tank crowns, are announced by the Brown Instrument Co., Philadelphia. The improvements will result, it is said, in longer service life for the protecting tube assembly and will facilitate removal of the thermocouple assembly for periodic inspection.

The major improvements were said to consist of replacing with heat resisting stainless steel the secondary protecting tube previously made of steel. The change, it is added, will reduce oxidation to a minimum, eliminate freezing of the tube, and permit its removal for inspection. It is understood the change will become effective on orders after July 1.

McGill Type IR Inner Race and Roller Assembly

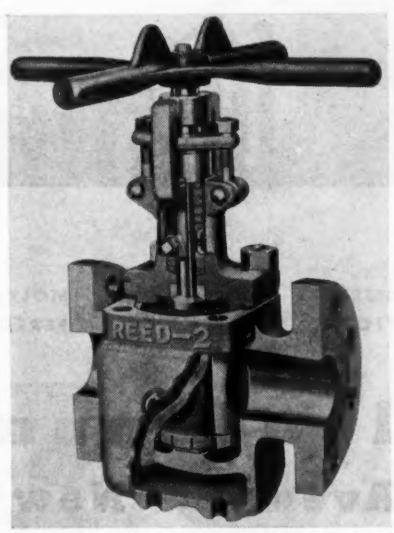
This new type McGill Inner Race and Roller Assembly Solidend Multirol Bearing may be used to great advantage on applications where parts which have been heat treated to obtain surface hardness can be utilized as outer raceways. Designed as a self-contained unit and made in both single and double row, the new Bearing is similar in style to the established line of Solidend Multirol Bearings.

Rounded end rollers give greater load capacity; absence of loose retaining rings simplifies installation; close tolerance and great rigidity give greater Bearing efficiency and eliminate vibration and noise; there are no delicate parts to warp, break or loosen. Rugged and long lasting, races and rollers are made from thorough hardened high-carbon chrome steel.



The McGill Manufacturing Co., Inc., of Valparaiso, Indiana, who make this new Inner Race and Roller Assembly, advise that a typical application utilizing this Inner Race Assembly is the constant mesh gears in transmissions. The ground bores of the hardened gears act as outer raceways. The small radial space required by this Solidend Multirol Bearing, and the great load carrying capacity, especially under static conditions, inherent in such bearings, are taken advantage of. A new Bulletin No. IR-45 now available gives further details.

The Reed Jacketed Steel Valve



Many materials such as: Tars, Waxes, Sulphur, Asphalt, Pitches, Petroleum residues, Molten Caustic etc., are very viscous and tend to harden and congeal at ordinary temperatures. These materials must be kept fluid for transmission through lines and fittings.

To meet the demands of these services Reed Jacketed Steel Valves have been developed by the Reed Roller Bit Co., P. O. Box 2119, Houston 1, Texas. The effective Jacketing design, plus the easy operating characteristics and cleaning action of the discs, assure dependable operation at all times. Reed Valves do not require lubrication, and maintenance costs are a negligible factor.

Expansion and contraction, due to temperature changes, does not affect the action of the Reed Valve discs, which are accurately guided by the disc holder, yet are free to float with respect to the holder and the body seat. This construction is assurance against sticking and the detrimental affects of expansion and contraction under temperature.

Reed Jacketed Steel Valves are interchangeable with wedge gate standard steel Valves and are supplied with A. S. A. standard for O. S. and Y wedge gate valves.

Electronic Air Filtration Equipment

Recently introduced by the American Air Filter Co., Inc. into their electronic line of air filtration equipment is the Electro-Mist, a self-contained, completely demountable electronic unit designed to collect oil mist from high speed cutting tools or welding fumes in light concentrations.

An axial flow fan mounted on top of the unit draws air from the operation which is properly hooded thru piping or flexible tubing into the base of the unit. In its application to cutting operations, the mist-laden air first passes thru a permanent unit filter to remove any metallic dust or large drops of oil, then enters the ionizer in which the mist and smoke particles receive an electrical charge before passing into the collector unit where they are precipitated on the plates. The collected oil mist accumulates and drips off the lower edge of the plates, thru the filter and into a reservoir below. As much as 2 or 3 gallons of oil can be salvaged daily and may be piped back into the machine tool or drained off as preferred.

Several new and exclusive features of the Electro-Mist Collector are claimed to improve

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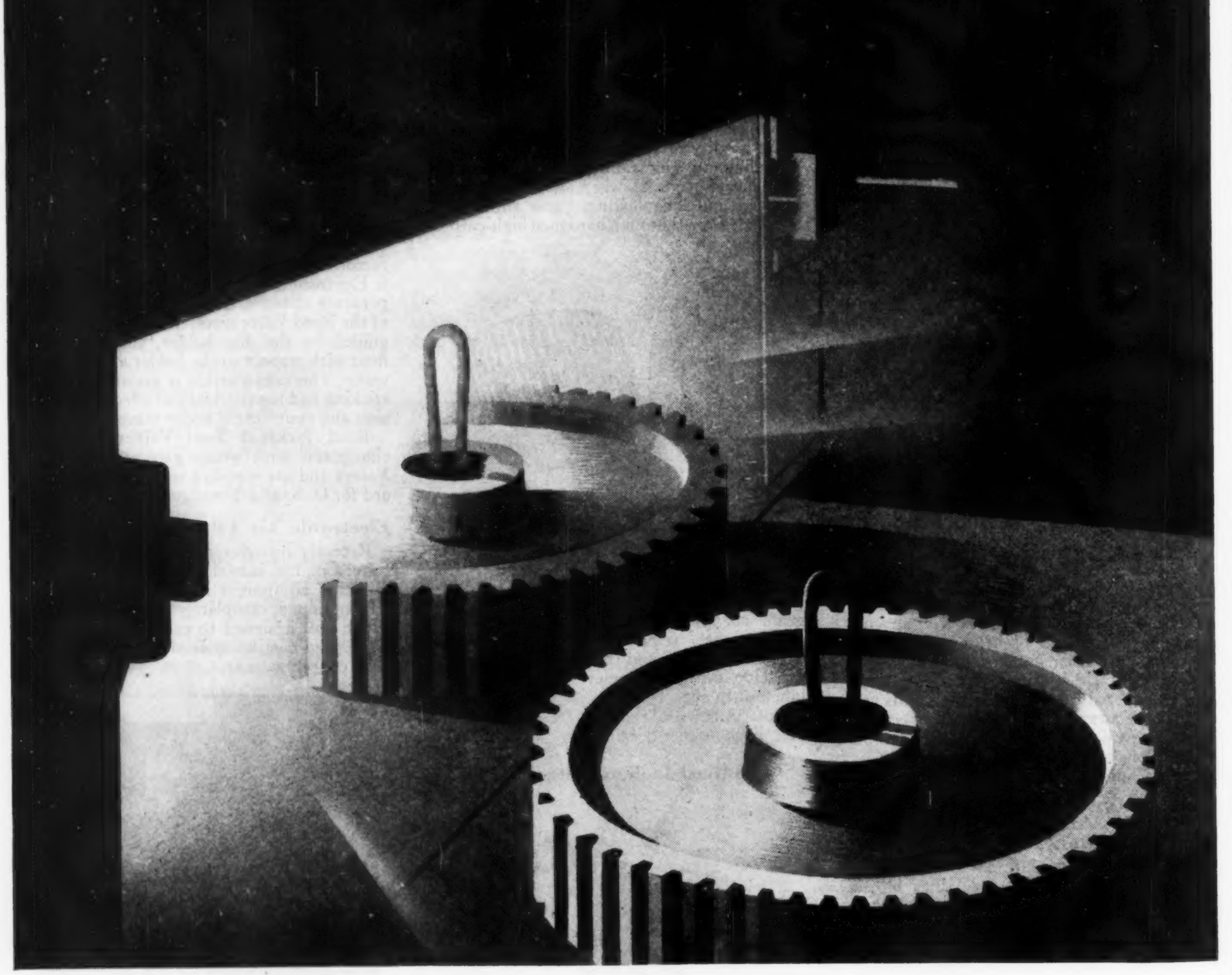

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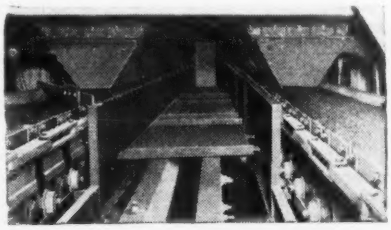
performance and simplify maintenance. A removable panel gives full access to all parts which are removable without tools of any kind. The operator is protected from any possibility of electrical shock, since turning the latches to remove this panel shuts off the current to the power pack and all charged parts are short circuited to remove any residual static charge. The filter and ionizing units slide out of the casing and the collector unit tilts forward permitting the removal of the collector plate assemblies for washing or inspection at any location convenient to water and sewer connections. The 7" diameter intake may be turned so as to enter from any side of the casing and the floor support, which provides space to drain the oil pan, may be omitted with overhead or wall mounting.

The Electro-Mist is made in one size—$28^3/_4" \times 20^3/_4" \times 70"$ high. The power pack operates from nominal 115 volts 60 cycle single phase. On multiple installations one large power pack will handle as many as 10 Electro-Mist collectors. Complete details can be had by writing for Bulletin #251, American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.

Link-Belt Sidekar-Karrier, New Conveyor for Bulk Material

The development of an entirely new type of conveyor, to be known as the Link-Belt Sidekar-Karrier, designed to handle bulk materials in a horizontal run-around path, within minimum headroom, is announced by Link-Belt Co.



The new Karrier provides conveyor storage for materials that are to be discharged simultaneously in varying quantities at a number of points.

Any surplus material that is still left in the conveyor buckets after they have served the several discharge points, will remain in the buckets, to be recirculated.

The conveyor is both (1) self-feeding from any one of many feed spouts which may be located above its horizontal run-around path of travel, and (2) self-discharging to any number of points, thus permitting continuous automatic operation.

Another feature that makes the Sidekar-Karrier different from other types of horizontal plane run-around conveyors is the fact that the material is carried in buckets supported on rollers, rather than being dragged by flights in a trough.

The design is such that two or more materials can be separately fed to the conveyor with the assurance that the admixture will not be disturbed in transit, and that it will be delivered to any predetermined discharge point in exactly the same mixed proportions as prevailed at the feed points.

The Link-Belt Sidekar-Karrier is available in two types.

Type 1 is recommended for boilerhouse applications, where coal is kept in bunker storage and delivered to one or more scale hoppers, as in cases where each boiler is fitted with individual weigh scales.

As the Sidekar-Karrier requires only from one to two feet of vertical clearance, it can be

Continued on Page 30

• Keep Informed

installed in boilerhouses previously equipped with overhead bunker and stoker spouts, if the installation of individual weigh scales for the boilers is desired.

This method not only provides automatic handling of coal, but has the further advantage of eliminating the dust nuisance.

Type 2 Karrier has been designed and installed to handle capacities of up to 100 tons per hour, and is ideal where it is important that the material does not suffer either from degradation or segregation.

A good example is that of a coal washery installation using concentrating tables for the cleaning of $^3/_4'' \times 0$ coal and where a uniform size of coal is desirable for higher efficiency of the concentrating tables.

On this installation, the Sidekar-Karrier is able to deliver a uniform feed to as many as 20 tables, and at the same time permits an orderly arrangement of the tables in such a way that economy of building construction is effected.

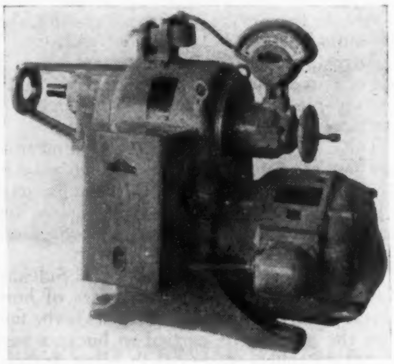
Both Type 1 and 2 Sidekar-Karriers are adapted to the efficient handling of other bulk materials besides coal. Handling magnesium pellets without degradation, for example, is being done with the Sidekar-Karrier.

Additional information on the Link-Belt Sidekar-Karrier will be found in new Link-Belt folder 2068, a copy of which will be sent to any interested reader on request.

Request may be addressed to Link-Belt Co., 300 West Pershing Road, Chicago (9), Ill., or to the nearest office of the company.

Test Stand Drive

Now available to Industry in a variety of sizes, types, and operating characteristics, the U. S. Test Stand Drive can be furnished with a cast iron frame or an aluminum frame where light weight is required. Composed of an across-the-line starting type motor directly connected to a variable diameter pulley transmission, this compact electro-mechanical power conversion unit is ideal for testing generators, fuel pumps, hydraulic systems, and various other types of mechanisms.



Marketed in sizes of 5 HP, $7^1/_2$ HP, 10 HP, 15 HP, and 25 HP, affording testing speeds from 1,100 RPM to 13,000 RPM, these Test Stand Drives are capable of accommodating various types of units to be tested through a wide range of testing speeds.

Features which offer exceptional appeal are, choice of either Single Head Mounting Brackets at take off shaft or Dual Head Mounting Brackets with double take off shafts; horizontal or upright designs; mechanical or electrical remote controls; mechanical or electrical speed indicating meters. These units were originally developed for and received the approval of the Army Air Corps and have found many uses in the Services and Industry with respect to supplying an ideal medium for testing many dif-

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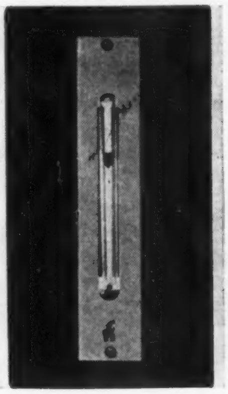
ferent types of electrical, mechanical, hydraulic, pneumatic, reciprocal, rotating, constant operating, intermittent operating, or experimental machinery of all types.

For further information and Bulletin write to U. S. Electrical Motors, Inc., Department CEG, Los Angeles 54, Calif. also Milford, Conn.

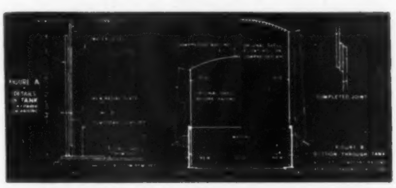
New Panel-Mounted Rotameter



Designed to answer the growing need for panel centralization of instruments that indicate pressure, flow, temperature, etc., the new Schutte & Koerting panel-mounted Rotameter offers several advantages. Although the instrument itself is basically the S-K. Universal Rotameter, the panel-mount has a frosted glass window with a central clear-glass aperture and is installed flush in the panelboard, with the Rotameter supported directly behind. Provision is made for adequate back-lighting and ready maintenance accessibility.

New Mushroom Technique for Enlarging Storage Tanks Adds up to 100% Capacity

A new method by which liquid storage tanks may for the first time be enlarged to as much as twice initial size without dismantling the original structure has been developed by the Stacey Bros. Gas Construction Co., Cincinnati—one of the Dresser Industries.



The old tank is literally boosted to new capacity height, as new rings are added at the base by a patented process which makes use of virtually all of the original structure in assembled form. Such re-use, along with the utilization of the original foundation and the minimum dislocation of connections, contributes much to the economy of the process as well as to the speed with which a job may be completed.

Providing for the first time an alternative to new tank construction to increase storage capacity, the Stacey Bros. method will be particularly useful where facilities are crowded and there is room only for expansion upward.

As much as 100% additional capacity may be added by Stacey men, who cut the existing tank shell at the base, add new radial plates, and build a new shell around the old structure to give the desired height. Water is then run into the tank up to the new shell level, so that compressed air may be introduced to float the old cover shell up to the new level. Various controls hold the tank steady and level to $^1/_{16}''$, while 4″ filler plates are inserted between the shells, and the two units are tack welded in place.

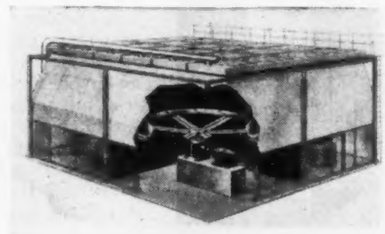
Continued on Page 32

• Keep Informed

When air pressure is released, and the water drained from the tank, the two shell sections and fillers are completely seal welded on the outside. Inside, the old shell is trimmed and welded at intervals around its circumference, and the enlarged tank is ready for connections and service.

Originally developed to obtain better buoyancy control of petroleum storage tanks in areas subject to flood, the new method can be used to build up tanks having either umbrella type roofs, or roofs supported by center columns. The inherent economies of this method are expected to be of widespread significance in the busy days ahead.

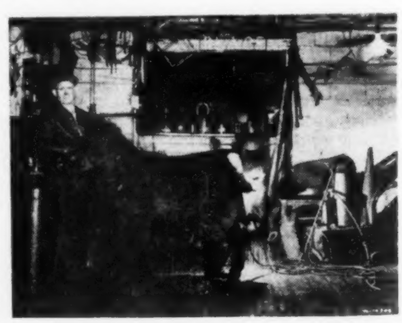
Fin Fan Cooling Unit



Cooling sections employing the highly efficient K-fin tube construction are cooled by forced draft fed by air from the cooler layer at ground level and supplied by fans with variable pitch blades and with variable speed drive. Vertical air flow against static head assures even air distribution over cooling surfaces. Fin Fan Units are designed for pressures to 5,000 psi and temperatures to 1,500° F. Coils are located to provide sufficient static head for pump suction. Tubes can be removed and replaced quickly and all mechanical equipment is readily accessible from the ground. The Fin Fan Unit embodies the combined experience and engineering skill of The Griscom-Russell Co. and The Fluor Corp., Ltd. A bulletin describing the construction and application of this new unit is available on request to The Fluor Corp., Ltd., 2500 South Atlantic Blvd., Los Angeles 22, Calif.

Blacksmith Re-Soles Horseshoes with Electric Arc Methods

Although the process of arc welding has invaded practically every known field of metal working including the blacksmith shop, the aged art of horseshoeing has maintained a unique position as an industry in that it is still linked to such conventional tools as the forge and anvil.



Now even the blacksmith's traditional horseshoeing methods have given way to modern shielded arc welding, according to authorities of The Lincoln Electric Co., Cleveland, Ohio. The claim is based on the successful experience of Charles H. Chism, veteran blacksmith of Coshocton, Ohio, who recently visited the Lincoln plant where he explained how he builds up worn shoes by

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electric welding without removing and replacing the shoes on the horses' hoofs.

Believed to be the first blacksmith ever to successfully practice this idea, Mr. Chism produced the accompanying photo which shows him actually rebuilding the toe and caulk of a mine pony's shoe with his shielded arc welder.

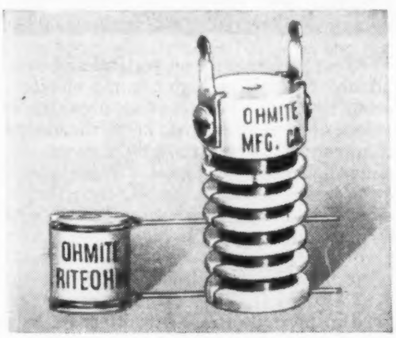
"The shoes wear down," said Chism, "especially in icy weather or in use on paved roads. Electric welding does away with the need of taking shoes off and putting new ones on for the old ones can be built up a couple of times this way very nicely." He adds that the horse's shoe does not get as hot as when originally put on, in which case it is red hot so that it can be shaped to fit the hoof. After the welding operation, the horse's hoof is cooled by pouring on water. A light coated, high carbon electrode of $^1/_8$-inch diameter, specially designed to resist shock and abrasion, is used for these horseshoe re-surfacing jobs.

Mr. Chism, who has been behind the anvil for 53 years, insists that horseshoers need not be afraid of applying the electric arc in this work. If the horse is the high-spirited type that may scare from the flash, a blanket should be held over its head and it will stand quietly.

New Ohmite Riteohm Precision Resistors

Two new series of Riteohm Precision Resistors—Series 82 and 83—are announced by the Ohmite Manufacturing Co., Chicago. These are additions to the Ohmite Precision Resistor family which includes the well known Series 71, 81 and 90.

The new units may be mounted by means of a through-bolt. The Riteohm 82 has two lug terminals at one end firmly fastened by screws. The Riteohm 83 has radial wire leads.



Both new units are pie-wound to 1% accuracy. Specially enameled alloy resistance wire is non-inductively pie-wound on a non-hygroscopic ceramic bobbin which has a hole through the center for a No. 6 screw. After being wound, the units are vacuum impregnated with a special varnish which provides additional insulation and thoroughly protects the winding against humidity. The resistors can be supplied with a varnish coating containing a fungicidal agent, thus making the units particularly suited for use in the tropics.

The Riteohm 82 is available in three sizes—$^{11}/_{16}''$ diameter by $1^1/_8''$ long, $1^7/_{16}''$ long or $1^3/_4''$ long for the 2, 4 and 6 pie units respectively. The minimum resistance is .1 ohm for all units and the maximum is 400,000 ohms for the 2 pie unit, 750,000 ohms for the 4 pie, and 1 megohm for the 6 pie unit.

The Riteohm 83 is available in three sizes—$^1/_2''$ diameter by $^7/_{16}''$ long, $^5/_8''$ long or $1''$ long. The first two units are 2 pie while the third is

Continued on Page 34

a 4 pie unit. The minimum resistance is 10 ohms for all units and the maximum is 200,000 ohms for the small 2 pie unit, 400,000 ohms for the large 2 pie, and 800,000 ohms for the 4 pie unit.

A few common applications for these resistors are voltmeter multipliers, laboratory equipment, radio and electrical test sets, attentuation pads, and electronic equipment requiring extremely accurate resistance components.

For further information write for Bulletin No. 125 to the Ohmite Manufacturing Co., 4835 Flournoy Street, Chicago 44, Ill.

All-Position Welding With A-C

The use of a-c welding, particularly for vertical and over-head work, has been hampered by the lack of an all-position a-c electrode capable of producing highest quality weld metal. Long a research project, an a-c electrode, known as the ACP, has emerged from Westinghouse laboratories; it meets the requirements of the U. S. Navy Department Bureau of Ships and the standards for welding set by various associations. The new electrode includes an arc pacifier that prevents excessive spatter loss during the negative half cycles and an arc stabilizer to aid in reestablishing the arc after each current zero.

For best performance on vertical and overhead arc welding, a high-organic electrode coating is used. This coating provides an envelope of burning gas that keeps the oxygen and nitrogen in the atmosphere from contaminating the weld metal. This type of coating leaves but a scanty slag over the deposited metal that does not interfere with welding. Curiously, this high-organic coating works in a satisfactory manner when the current flows in one direction but not the other. Obviously, d-c welding is easily performed in these positions but alternate half-cycles of a-c welding would be unsatisfactory. This restriction has impeded the progress of the much simpler a-c welding for sone fifteen years. Good reverse-polarity (electrode positive), all-position, d-c electrodes have been available for years. The secrets of the prerequisite coating for all-position, a-c welding began to unfold some two years ago.

The coating of an a-c welding electrode must provide a number of factors, indispensable to a satisfactory weld. Protection from atmospheric gases, scanty slag, no slag interference with the arc, adequate drive and penetration without undue spatter loss, are some of the factors dependent upon a proper coating.

In addition, two factors of great importance in a-c welding are arc stabilizing and "arc pacifying." When the current goes through current zero, the arc is extinguished and the coating must provide an enveloping atmosphere of highly ionized gas so that the arc will restrike for the succeeding half cycle. Also, assuming the current during the first half cycle has been flowing in the reverse-polarity direction (the direction in which

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high-organic coatings operate best), the correct amount of "arc pacifier" must be provided for the next half cycle to prevent excessive spatter loss, at the same time avoiding loss of drive and penetration.

The availability of an electrode capable of producing welds in overhead and vertical positions, having the high ductility and freedom from porosity necessary to meet the most rigid code requirements, has further accelerated the use of a-c welding.

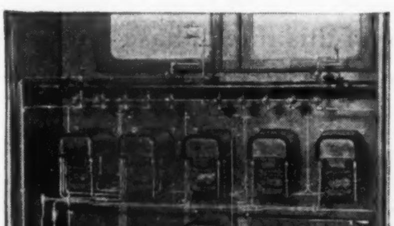
Wire Rope Slings to be Registered for Safety

American Chain & Cable Co., Inc., Bridgeport, Conn., has recently announced on behalf of its two wire rope divisions, the American Cable Div. and the Hazard Wire Rope Div., that their several types of wire rope slings may now be accompanied by a Certificate of Test and Registry for the benefit of the sling user. The policy of selling Registered slings is new to the entire wire rope industry.

There are several user advantages resulting from this Registered Service. All Registered slings are made from Preformed wire rope of Improved Plow Steel. All Registered sling terminals develop the full strength of the sling body. Many Registered slings will carry the new "Acco-Loc" Safety Splice. The "Acco" Certificate of Test and Registry furnishes a permanent record of the original strength rating of the sling, the safety factor upon which that rating was based, the actual proof load, and conditions of the sale. Each sling carries a metal tag which shows registry number, sling type, and maximum load rating.

This registered program includes all of the following types of wire rope slings—the conventional wire rope slings, braided wire rope slings and cable-laid slings. "Acco" Registered slings are made with "Acco-Loc" Safety Splice, Armored Loop, Acco-u Loc, Tru-Loc and Socket Terminals. All these terminals develop 100% of the rated wire rope strength.

Prefabricated Boiler Control Panel



Prefabricated boiler control panels which include all necessary connecting piping and electrical wiring for the operation of metering equipment and boiler control systems are now offered by Bailey Meter Co., Cleveland 10, Ohio, to simplify the users problem of installation. These panels which are factory fabricated and tested by experienced instrument mechanics are said to save installation time, to insure the use of suitable materials, to reduce total installed cost, and to present a neat, pleasing appearance. All piping and

Continued on Page 37

• Keep Informed

wiring necessary for operation is installed as a unit according to a coordinated and prearranged plan instead of as piecemeal operations by various contractors in the field.

Small units such as valves, relays, switches, signal lights, and the more sturdy and lightweight instruments are mounted and connected ready for service. Heavy instruments or instruments having delicate mechanisms are shipped separately; but cutout spaces, drilling and all necessary connections are provided so that their installation in the field is a foolproof, quick and easy operation.

Connecting piping and electrical wiring are brought to convenient terminals which are carefully tagged so that no time or effort is lost in connecting the prefabricated boiler control panel to the various factors which it controls.

A New Process for Making Ethyl Chloride

A new process for making ethyl chloride, one of the most important chemicals used in manufacturing Ethyl fluid to produce high octane gasoline powering allied air fleets on the world's battlefronts, is announced by Ethyl Corp. A $750,000.00 unit employing this process is now under construction at the company's Baton Rouge, La. Plant.

The process yields ethyl chloride by reacting chlorine with waste products from one of the present ethyl chloride units at Baton Rouge. It was developed in view of the "tight" supplies of both alcohol and ethylene, compounds used in producing ethyl chloride, through two present processes.

The principal use of ethyl chloride is in making tetraethyl lead by combining it with an alloy of lead and sodium. Tetraethyl lead comprises about two-thirds of Ethyl fluid and does the work in taking out the "knock" in gasoline.

Ethyl chloride also is used in dentistry as an anesthetic on abscessed gums, as a general anesthesia in short operations with the advantage of no after-effects, in producing ethyl cellulose which is the basis for certain plastics, as a catalyst in synthetic rubber manufacture, as a constituent of cognac essence and sometimes as a refrigerant.

Because of the enormous amounts used in making tetraethyl lead, Ethyl Corp. is the world's largest producer and consumer of this chemical compound.

Chlorine for the new process is produced by breaking salt electrically into chlorine and sodium. The sodium from this electrolysis is combined with metallic lead to form a lead-sodium alloy used in making tetraethyl lead.

The two methods already in operation for making ethyl chloride are based (1) on the hydrochlorination of alcohol, and (2) on the hydrochlorination of ethylene. In the alcohol process, ethyl alcohol vapor and hydrochloric acid combine in the presence of a catalyst to form ethyl chloride and water.

In the ethylene process, ethylene gas is mixed with hydrogen chloride gas in the presence of a catalyst. The two gases first are passed through a reactor where hydrochlorination occurs, and later through a "flash drum" which distills off the lighter ethyl chloride fractions, leaving the heavier polymer fractions. The ethyl chloride then is purified by fractionation. The first of two plants using the ethylene process was built in 1939.

The new process was developed because of increasing wartime demands for raw materials. Before the war, Ethyl Corporation converted all the chlorine from electrolysis of salt to hydrogen chloride to make ethyl chloride, and brought additional amounts of

Continued on Page 38

chlorine elsewhere. Due to rising wartime demands for tetraethyl lead and for chlorine in other uses, the company overproduced sodium in 1941 to obtain more chlorine, discontinuing open market purchases of chlorine, and storing the surplus sodium.

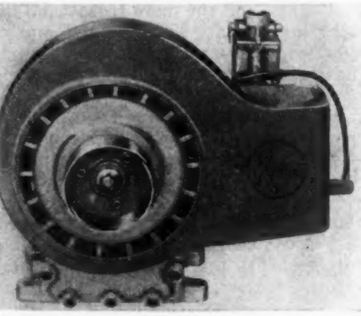
When nationwide chlorine supplies became critically short, Ethyl Corporation expanded its plant facilities to substitute hydrochloric acid for chlorine, producing the hydrochloric acid from sulphuric acid and common salt.

Then ethyl alcohol, used in making detonating powders and butadiene for synthetic rubber, came increasingly into demand. Construction of a second ethylene plant at Baton Rouge for the production of ethyl chloride helped to relieve the supply situation in ethyl alcohol.

As the war progressed, supplies of ethylene in the Baton Rouge area became inadequate in meeting the continuously increasing demands for ethyl chloride needed to manufacture Ethyl fluid for the war effort. When the new plant is in production, Ethyl Corporation expects to meet all increased requirements for ethyl chloride for tetraethyl lead without additional drain upon available supplies of alcohol or ethylene.

Revolutionary 5-Hp Engine Announced

A revolutionary, 5-hp, all-purpose air-cooled engine that embodies principles which are new in small engine design and manufacturing, has just been announced by Kinner Motors, Inc., Glendale, Cal., engine manufacturer for the past 26 years.



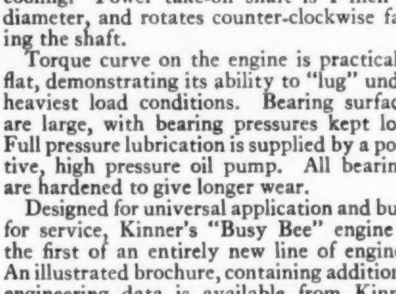
Called the "Busy Bee," the Kinner model AB-3, is an air-cooled, 4-cycle, L-head engine rated 5 hp., at 2600 rpm, but develops 6 hp., at 3250 rpm. The single cylinder is horizontal and detachable, making maintenance easier. Bore is $2^3/_4$ inches, stroke 3 inches, displacement 17.8 cubic inches. The whole unit requires only 2.4 cubic feet of space, hence is compact.

The "Busy Bee" is the lightest engine on the market in its horsepower class. This is due to aluminum alloy used in crankcase, piston, head, and crankcase and rear cover. Light weight of the "Busy Bee" is attractive to equipment manufacturers who are building portable units, and proves improved cooling. Power take-off shaft is 1 inch in diameter, and rotates counter-clockwise facing the shaft.

Torque curve on the engine is practically flat, demonstrating its ability to "lug" under heaviest load conditions. Bearing surfaces are large, with bearing pressures kept low. Full pressure lubrication is supplied by a positive, high pressure oil pump. All bearings are hardened to give longer wear.

Designed for universal application and built for service, Kinner's "Busy Bee" engine is the first of an entirely new line of engines. An illustrated brochure, containing additional engineering data is available from Kinner Motors, Inc., Glendale 4, California.

New Armor-Clad, Fully Insulated Electrode Holder



A new armor-clad (screw type), fully insulated electrode holder has been announced by the Electric Welding Division of the General Electric Company. Designed from the operator's viewpoint the new holder is recommended for use wherever durability, maximum safety, and minimum operator fatigue are desired.

A feature of the new holder is its head, which is completely enclosed in a sheath of aluminum armor. This armor protects the insulation, resists weld spatter, and eliminates the possibility of accidental contact with the welding circuit. Thus the holder remains

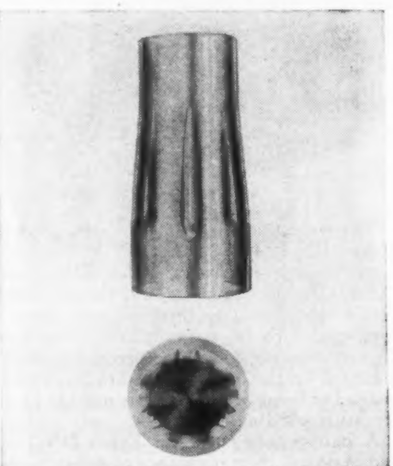
• Keep Informed

clean while in use and lasts considerably longer than insulated holders without armor cladding.

Designed to accommodate electrodes up to and including $^1/_4$ in. in diameter, the holder is easy to use, light in weight (15 oz), and unusually cool in operation. A slight twist of the hand tightens or releases the electrode. While in use, the holder firmly grips the electrode at the proper angle and good current contact is maintained. This keeps the holder cool, tends to prevent overheating of the electrode, and maintains a uniform melting rate clear down to a stub end. The threads of the push-up rod do not carry current. A soldered cable connection also helps the holder to remain cool. The width of the electrode slot limits the size of the electrode which can be inserted, thus preventing overloading, one of the evils which materially shorten the life of electrode holders.

New Rotameter Tube

Fischer & Porter Co. announces a new patented Rotameter tube made of borosilicate glass that greatly simplifies rotameter construction. It is called the "Bead-Guide Tube" and has three straight glass ribs running up the inside of the tube to guide the rotameter float throughout its travel. A cross-section of the tube is shown in the illustration. There is only a hair line contact between the float and each raised rib.



A guided float improves the accuracy of the rotameter by centering the float and it also prevents tube breakage. Furthermore, it permits float shapes that are not stable without guides, thus making possible the well-known Stabl-Vis float of this Company for measuring fluids of varying viscosity with high accuracy.

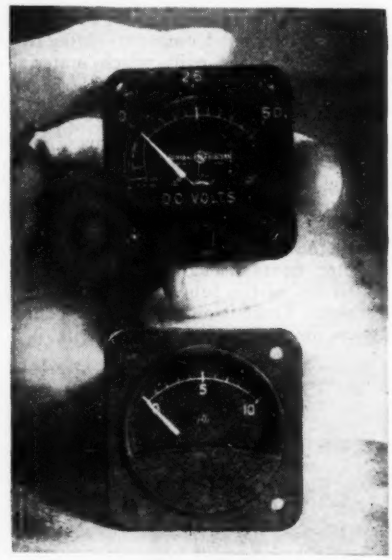
The "Bead-Guide Tube" simplifies rotameter construction because it eliminates the center guide wire previously used to stabilize the float. Also, it solves completely the problem of how to guide the float when very corrosive chemicals, such as hydrochloric acid, are being measured. The three ribs running up the rotameter tube also give it greatly increased strength. For these reasons, the Bead-Guide Tube is expected to outmode the present tension-guide wire construction and the old style rotameter tube. The new tube can be readily adapted to existing rotameters. If you are having trouble with tube breakage in free-float meters, or if guide rods are corroding, get in touch with Fischer & Porter Company, 97 County Line Road, Hatboro, Pa., giving full information in regard to your rotameter, its size, flow range and the fluid being metered.

Continued on Page 40

• Keep Informed

1½-Inch Electric Indicating Panel Instruments

A new line of 1½-inch electric indicating panel instruments, components of most communication and electronic devices, has been announced by General Electric's Meter and Instrument Division. To meet the need of the Armed Forces for smaller, more compact, and weather-resisting equipment, two forms are available: a watertight design for application where the equipment may be accidentally submerged in water, exposed to rain, or used in extremely humid climate; and a conventional design for use in aircraft or for other service where the instrument will be protected from the elements.



The watertight instruments are known as Types DN-1, DN-2, and DN-3, while the conventional are Types DN-4, DN-5, and DN-6. Both instruments have the same basic design in utilizing an internal-pivot element combined with the permanent-magnet moving-coil construction. The pivots are solidly mounted on the inside of the armature shell, instead of being secured to the outside of the armature winding.

A waterproofing test for Types DN-1, -2, and -3 proves their resistance to moisture and leakage when submerged in 30 feet of water for 24 hours. Both types will withstand vibration tests specified in American War Standard ASA Specification C-39.2-1944. They are available in nearly all ratings for direct-current, radio-frequency, and audio-frequency measurements, and are mostly for use with external thermocouples or rectifiers.

Cooper-Bessemer Adds Second Star to Army-Navy "E" Pennant

Mount Vernon, Ohio—Further recognition for outstanding production of Diesel engines came to The Cooper-Bessemer Corp. in the announcement that its Grove City, Pa. plant has been awarded a second renewal on its Army-Navy "E" originally presented April 8th last year.

The announcement came in a letter dated recently from Admiral C. C. Block, U. S. Navy, chairman of the Navy Board of Production Awards.

In addition to the Army-Navy "E" pennant with two stars, the company flies a five-starred Maritime "M." The 112-year old concern has been one of the most important factors in the outstanding development and manufacture of Diesel power for propulsion and auxiliary service in many types of cargo, combat and salvage vessels. The company is

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also recognized as a major producer of Diesel and gas operated compressors for the petroleum and synthesis industries.

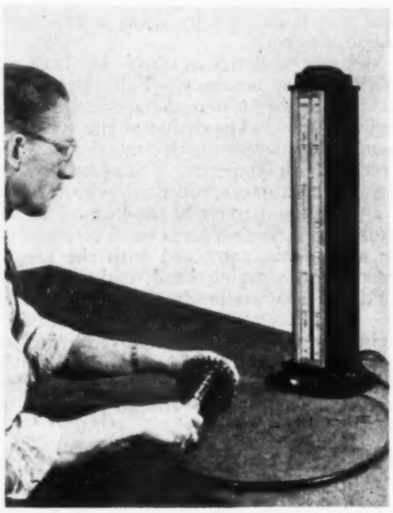
Appreciation for sustained war production was expressed by Admiral Block in his announcement of the second renewal of the "E" award.

Federal Products Corp. to Distribute New Air Gaging System

Federal Products Corp., Providence, R. I., are exclusive sales agents for a new air gaging system manufactured by Metrical Laboratories, Inc., Ann Arbor, Michigan, known as Federal Metricator System of Dimensional Gaging by air.

This system consists of a graduated column, and a gaging head. A manometer tube, built into the water column, indicates variations in the air pressure.

The standard gaging head is constructed with two measuring orifices which are recessed with respect to the outer skirt of the gaging member. This recessed construction of the orifices of the gaging head, permits a part whose surface is easily marred to be precisely



gaged without the surface of the part actually touching the gaging member. This recessed design of the gaging head contributes to the maintenance of operating accuracy, due to the fact that the protective outer skirt of the gaging member can wear considerably before the two measuring orifices themselves show signs of wear.

As the space between the measuring orifices and the part being gaged increases, the air flow increases and the water column rises in the manometer tube. This results in a plus reading when gaging a hole diameter. If the diameter of the hole being gaged is undersize, the air flow is decreased, and this is expressed by a minus reading on the scale.

The metricator scale is calibrated to a high degree of accuracy, and it does not require high or low limit Gages, only one master being required for each gaging head. When this master (which is a regular part of the Federal Metricator Air Gaging System) is applied to the gaging head, the scale reads at zero. The master is made from high grade tool steel chromium plated and lapped to the highest possible standards of dimensional accuracy.

By building a reduced size measuring orifice, holes as small as .156" diameter and shoulders as narrow as .0937" can be precisely measured. Slots and grooves can be gaged from .0937" thick and up. Gaging

Continued on Page 42

• Keep Informed •

heads in general will measure external diameters from .500" diam. up.

Federal Metricator Air Gaging System operates under air pressure of approximately one pound. The system can be attached to the regular plant air supply. If attached to a high pressure line, a regulator at the instrument will bring the pressure down to the proper level. Variations in the air line pressure do not affect accuracy of readings on the scale, as the pressure in the gaging system can be kept constant by maintaining the water in the instrument at the proper static level.

Amplification is four thousand to one, which means that measurements within .000025" are easily readable on the scale. One ten thousandth of an inch is represented by approximately $^1/_2$" on the scale.

Practically any inside dimension down to $^1/_8$" diameter and any outside dimension down to $^1/_4$" in diameter and other dimensions of depth, width, etc., can be gaged singly or together.

Diametral pitch, taper, bell mouth, barrel shape, and out-of-round can be precisely gaged in one operation. Stepped holes, or holes having several diameters can be measured simultaneously by using a composite gaging member.

Moisture or sludge in the air line does not affect reading accuracy. Full tolerance is maintained throughout the entire life of the gaging system. The design of the system is such that replacements of parts due to wear is reduced to a minimum. The effective range of the metricator is approximately .002".

The high sensitivity of the Federal Metricator Gaging System gives quick response on the scale—this, combined with the unique design of the gaging head, makes possible rapid and accurate production gaging. This new system combines the best elements of gaging by air hitherto employed, together with special features of construction which are unique. The result is a system of gaging by air which is highly efficient, as well as versatile.

Lincoln Foundation Publishes Rules for Textbook Award Program

A twelve-page brochure, covering the object and purpose of the Award Program for Textbooks in Modern Design and setting forth all rules and conditions governing the program, has just been published by trustees of The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

The brochure is the official document of the new Award Program as announced by the Foundation in April to encourage preparation of Textbooks on design for use of engineering undergraduates in machine design and in structural design for fabrication by

• Keep Informed

all processes including welding. It thoroughly covers the types of subject matter to be treated in these two important fields, listing the awards which are divided into the two classes and which total $20,000.

The attractively printed pamphlet carries such explanatory paragraphs as those dealing with royalties for manuscripts of award-winning authors, method of payment of awards, eligibility requirements, bases of judgment in rating papers, how to present subject matter, and other pertinent facts designed to assist prospective participants.

The brochure, entitled, "$20,000 Award Program for Textbooks Covering Machine and Structural Design for Modern Processes Including Welding," may be obtained gratis by anyone interested. Requests should be addressed, Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Kropp Forge Makes Billionth War Forging

The Kropp Forge Co., Chicago, produced their Billionth War Forging on V-E Day plus one. Pictured at the drop hammer on which this airplane landing gear forging was made, are, from left to right, Roy A. Kropp, President; Joe Olenichak, Hammer Helper; Paul Alter, Heater; Herman Loescher, Hammersmith; James Meacham, Hammer Helper; John Zdon, Helper; and Raymond B. Kropp, Vice President and Treasurer of the company.

• BUSINESS CHANGES

Thomas Robins, Jr., Elected President

Thomas Robins, Jr., was recently elected president of Robins Conveyors, Inc., by board members meeting in Passaic. He succeeds Thomas Matchett, president since 1928, who announced that he is retiring from an active part in the management.

Thomas Robins, Sr., founder of the company and chairman of the board, in behalf of the company's directors expressed appreciation for the part Mr. Matchett had played over a period of many years in building up the company and expanding its business.

Thomas Robins, Jr., has been chairman of the executive committee for the past five years. Also he is president of Hewitt Rubber Corp. in Buffalo. Prior to moving to Buffalo in 1926 he was associated with Robins Conveyors for seven years immediately following the first World War, during which he had served as Commanding Officer of a division of sub-chasers operating in the Irish Sea.

Mr. Robins is vice chairman of the board of directors, National Synthetic Rubber Corp., Louisville, Ky., which operates one of the Government-owned synthetic rubber

Continued on Page 44

plants. He is also a director of the Federal Reserve Bank of New York, Buffalo Branch; the Marine Trust Company of Buffalo and Niagara Share Corp. Currently he is vice president of the Buffalo Chamber of Commerce.

Previous to Mr. Robins' election to the presidency, stockholders met recently at the company offices in Passaic and added Samuel C. Park, Jr., of New York City to the board of directors. Mr. Park represents the interests of Colonel John Hay Whitney, now overseas with the U. S. Army Air Forces.

All directors of the company were reelected. These are Thomas Robins, Thomas Robins, Jr., S. D. Robins, Thomas Matchett, T. W. Matchett, H. Von Thaden, James B. Taylor, Herman Goldman, Pierre Jay, Knight Woolley and F. G. Cooban.

Three New Directors Elected at Foster Wheeler

The election of three new directors to the Board of Foster Wheeler Corp. took place recently. An interesting point in this connection is that all three men have worked their way up to positions of importance in the company, none of them being from outside organizations.

The election of William L. Martwick, Lee A. Swem and Charles E. McCulloch as directors of Foster Wheeler Corp. was announced by J. J. Brown, Chairman of the Board. Each of the new directors has been associated with the Corporation for several years and is well known throughout the industry.

Mr. Martwick is Vice President in charge of general sales for Foster Wheeler. After spending several years in the work of fuel preparation, furnace design and combustion, he became President of the Aero Pulverizer Co., which was absorbed by Power Specialty Co. in 1926. The latter company then organized a pulverizer and furnace division with Mr. Martwick as Manager, an arrangement which was continued after Power Specialty was succeeded the following year by the Foster Wheeler Corp. In 1932 Mr. Martwick went to Chicago as Director of Foster Wheeler's western offices and five years later was appointed General Sales Manager with headquarters in New York. He has been a Vice President since 1940.

Mr. Swem has been the Corporation's patent counsel since May, 1936, and before that, while engaged in the practice of law, devoted a considerable part of his time to Foster Wheeler's patent problems. A native of Washington, D. C., he graduated from Georgetown University Law School in 1926 after first studying mechanical engineering at George Washington University and the Massachusetts Institute of Technology. He became an examiner in the U. S. Patent Office and then was associated with William G. McKnight in the practice of law in New York City, serving as patent attorney for such well known corporate clients as the Edward G. Budd Manufacturing Co., Packard Motor Car Co. and Standard Oil Co. of New York. When Mr. McKnight, who was Foster Wheeler's patent attorney, retired, Mr. Swem succeeded him.

Manager of Foster Wheeler's petroleum refinery division for the past eight years, Mr. McCulloch, the third new director, has had a wide experience in the field of chemical engineering. After graduating from Massachusetts Institute of Technology in 1926, he joined the National Carbon Division of the Union Carbide and Carbon Corp. as an analytical chemist and later became chemical engineer for the Tidewater Oil Co. He joined Foster Wheeler's refinery division in 1927 and ten years later was appointed manager of the department, in which position he has gathered together a corp of outstanding experts in the many phases of this complicated work.

New Corporate Title for Linear Packing & Rubber Co.

Linear Incorporated is the new title of the Linear Packing & Rubber Co. Change was effective as of April 20, 1945.

Having been known in the trade as Linear for a number of years it was decided to use Linear as their Corporate title.

Linear manufactures a complete line of mechanical packings and have specialized in the manufacture of Hydraulic Seals used extensively on airplane hydraulic systems; they have been a major supplier of seals for both Army and Navy planes.

A. W. Swartz, President of the Corporation, states the change in title involves no change in either personnel or policies of the Corporation.

Timken Elects Bergstrom Vice President

At a Board meeting held recently Albert L. Bergstrom was elected Vice President of all Engineering. Bergstrom, born in Sweden,

• Keep Informed

graduated from Royal Technical Institute in Stockholm, Sweden, in Mechanical Engineering, came to this country in 1924, and became designing engineer for the Stearns Conveyor Co. of Cleveland, Ohio. Bergstrom remained with Stearns until 1929 when he came with The Timken Company as Development Engineer. He was given various engineering and development assignments, later became Chief Works Engineer, and in 1938 was made Executive Engineer. In his new duties as Vice President of Engineering, he will have complete charge of all Engineering activities.

Westinghouse Elects Three Vice Presidents

Election by the Board of Directors of three Vice Presidents to head the treasury, law and patent departments, and lamp manufacturing and lighting equipment divisions of the Westinghouse Electric & Manufacturing Co. has been announced by A. W. Robertson, Chairman.

They are L. H. Lund, who has been treasurer since 1941; William E. Miller, who had been general attorney in charge of the law and patent department since 1944, and Ralph C. Stuart, in charge of the Lamp and Lighting Divisions.

Mr. Lund and Mr. Miller have their offices in Pittsburgh, Pa. Mr. Stuart will administer the four plants of the Lamp Division at Bloomfield, Belleville and Trenton, N. J., and Fairmont, W. Va., and the Lighting Division's Cleveland, Ohio, plant from the Lamp Division headquarters at Bloomfield.

Mr. Lund has been employed by Westinghouse since January, 1921, when he joined the accounting department of the Westinghouse Electric International Co. in New York City. Six months later he was elected auditor of the International Company, and in 1937 became assistant treasurer and assistant secretary of the Westinghouse Electric & Manufacturing Co. with headquarters in Pittsburgh. Born in Brooklyn, N. Y., Mr. Lund studied accounting at Pace Institute, New York City.

Mr. Miller, too, is a veteran employe. A member of the Company's legal staff for 30 years, he has lived in the Pittsburgh district all his life. He attended Shadyside Academy in Pittsburgh and Amherst College and received the degree of Bachelor of Law from the University of Pittsburgh in 1913. He was admitted to the Allegheny County Bar the same year.

Twenty-five years with Westinghouse in the United States and Canada, Mr. Stuart oined the Company at the Bloomfield Works as an assistant foreman in 1918. Soon after he entered the Army, but returned in 1919 and the following year was transferred to the Canadian Westinghouse Company in Hamilton, Ontario, where he became manager of the lamp plant in 1930. There he organized two foundries, a radio tube plant and a lighting fixture plant, operations which—together with the lamp-making plant—now comprise the West Plant of the Canadian Westinghouse Company. He was transferred to the Bloomfield headquarters plant of the Lamp Division in 1941 as manager of manufacturing.

Economics Expert Heads New Research Department

Charles E. Young, former supervisor of Economic Research, has been appointed manager of the newly-created Statistical Research Department of the Westinghouse Electric & Manufacturing Co., according to an announcement by F. D. Newbury, Vice President.

Continued on Page 46

In his new capacity, Mr. Young, specialist in industrial economics, will direct investigations into business conditions, and study relations of such general trends to Company activities. In addition, he will make special studies on questions referred to him by the Planning and Development Committee, headed by Mr. Newbury.

The Statistical Research Department also will cooperate with headquarters accounting, market research and statistical departments so as to avoid duplication of effort, and to apply all available information in its studies.

Born in Chicago in 1914, Mr. Young attended Glenbard Township High School, in Glen Ellyn, Ill., then Northwestern University, where he was graduated with degrees of Bachelor of Science in 1938 and Master of Business Administration in 1939. He joined Westinghouse immediately as a member of the economist's staff, and was appointed supervisor of Economic Research two years later, remaining in that post until the present appointment.

A member of the graduate faculty at the University of Pittsburgh, Mr. Young is chairman of the Postwar Planning Committee of the Pittsburgh Personnel Association, and of the Economic Research Committee of Westinghouse. He is a member of the Economic Advisory Group of the National Association of Manufacturers, the Conference of Business Economists, the Market Analysis Committee of the Producers Council, the American Economics Association, the American Statistical Association, the Committee on Mathematical Statistics of the National Research Council, the Demobilization Committee of the Allegheny Conference on Community Development, and the Sub-committee on Basic Industrial Statistics of the Advisory Committee on Government Questionnaires.

Briggs Clarifier Co. Adds To Staff

The Briggs Clarifier Co., of Washington, D. C., and Bethesda, Md., manufacturers of modern oil filtration equipment, has announced the appointment of Charles W. Miller, Jr., who has been actively associated with the aviation industry for more than 20 years, as a member of the engineering staff.

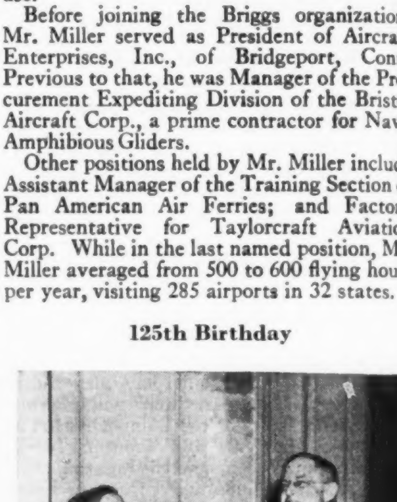
Mr. Miller is compiling special market data on oil and engine maintenance in the commercial aviation field, and is responsible for compiling test data on airlines equipment.

Although the capacity of the Briggs Clarifier Co. is now entirely absorbed in supplying Mobile Oil Clarifiers to the Army Air Forces and Navy Department, these units will be available for postwar commercial aviation use.

Before joining the Briggs organization, Mr. Miller served as President of Aircraft Enterprises, Inc., of Bridgeport, Conn. Previous to that, he was Manager of the Procurement Expediting Division of the Bristol Aircraft Corp., a prime contractor for Navy Amphibious Gliders.

Other positions held by Mr. Miller include Assistant Manager of the Training Section of Pan American Air Ferries; and Factory Representative for Taylorcraft Aviation Corp. While in the last named position, Mr. Miller averaged from 500 to 600 flying hours per year, visiting 285 airports in 32 states.

125th Birthday



Congratulations in order! Builders-Providence, Inc., %Proportioneers, Inc.%, and Omega Machine Co., recently joined to celebrate the 125th birthday of the parent Co., Builders Iron Foundry, with a Service Award Dinner for two hundred seventy employees who have been with the Company for five years or more. Illustration shows H. S. Chafee, President (right) congratulating Harry S. Dolbey, Builders Research and Service Man (left) upon his fifty-four years of continuous service.

American Brake Shoe Division Advances J. L. Mullin

The American Manganese Steel Div. of the American Brake Shoe Co. announces another advancement for J. L. Mullin with his current promotion from general superintendent of foundries to vice president in charge of operations. Mr. Mullin will carry on his new duties from the Amsco headquarters at Chicago Heights, Ill.

Associated with the manganese steel industry since 1914, when he joined the Edgar Allen Manganese Steel Co., forerunner of the present Brake Shoe Division, as a clerk in the annealing department, Mr. Mullin has advanced steadily through the offices of local purchasing agent, foundry superintendent,

• Keep Informed

works manager at the New Castle, Del., plant, and general superintendent of foundries.

The American Manganese Steel Div. of the American Brake Shoe Co. manufactures manganese steel castings for many industrial and war uses, as well as dredging and material handling pumps, reclamation and hard-surfacing welding materials and power shovel dippers. Foundries are located in Chicago Heights, Ill., New Castle, Del., Oakland, Calif., Denver, Colo., St. Louis, Mo. and Los Angeles, Calif. At Mahwah, N. J., the American Brake Shoe Co. maintains a completely equipped research department which includes a full-scale experimental foundry.

Woods Joins Lincoln Electric

The addition of Gorham W. Woods to its engineering staff has been announced by The Lincoln Electric Co., Cleveland, Ohio, world's largest producers of arc welding equipment.

Joining the company as research engineer, Mr. Woods will devote a major part of his time to the development of electrodes, a post for which he is well qualified in view of his many years of experience in the field of chemistry and metallurgy.

A graduate of Rice Institute of Houston, Texas, he received his B. S. degree in Chemical Engineering in 1923.

Mr. Woods was chief chemist of the Hughes Tool Co., of Houston for seven years, and development engineer of the same firm for 12 years. His duties included the design, manufacture and use of oil field tools and supervision of work in various steel mills and oil fields in the southwest and Mexico.

During the past three years he was process engineer of the Dickson Gun Plant, a Hughes-operated concern, where he had charge of the technical aspects involved in the manufacture of cannon by the centrifugal casting process.

A registered professional engineer in the states of Texas and Ohio, Mr. Woods is a member of the American Welding Society and in 1940–41 was Chairman of the South Texas Section. He has done considerable research and experimental work in the development of welding electrodes, materials and processes. He is also a member of the American Society for Metals and Tau Beta Pi fraternity.

Wickwire Spencer Names Franz Buffalo Plant General Superintendent

R. T. Dunlap, Vice President in Charge of Operations, Wickwire Spencer Steel Co. announces the appointment of Alvin F. Franz as General Superintendent of the Buffalo Plant of the company.

Mr. Franz, well known in the steel industry, was previously General Superintendent of the Allan Wood Steel Company of Philadelphia, Pa., a position he held for 15 years.

Previously he was Open Hearth Superintendent of the Otis Steel Co. of Cleveland, Ohio.

In his new position, Mr. Franz will be in charge of all production at Buffalo, including Wickwire Spencer's Open Hearth, Hot Mill and Wire Departments.

Price Named Westinghouse Executive Vice President

Gwilym A. Price has been appointed Executive Vice President of the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., according to an announcement by George H. Bucher, President. Mr. Price will report to Mr. Bucher.

Mr. Price was elected Vice President of the Company in September, 1943, and was elected to the Westinghouse Board of Directors in January of this year. His responsibilities had included settlement of the Company's war contracts.

Continued on Page 48

• Keep Informed . . .

Prior to his election as an officer of Westinghouse, Mr. Price had been President of the Peoples-Pittsburgh Trust Co., of Pittsburgh, since January 1940, following three years as its Vice President in charge of trusts. He had served as a trust officer since 1923 and as a Vice President of the bank since 1930.

Other companies of which he is a director include Blaw-Knox Co., National Union Fire Insurance Co. and the Peoples-Pittsburgh Trust Co.

Mr. Price is presently serving as treasurer of the War Advertising Fund of Allegheny County; Vice President and director of the Zoar Home; general trustee of Allegheny College; and trustee of the Pittsburgh Y.M.C.A., Elizabeth Steel Magee Hospital, Pennsylvania College for Women, and the British War Relief Fund.

Born in Canonsburg, Pa., in 1895, Mr. Price attended school in New Kensington and Carnegie, Pa., and was graduated from the University of Pittsburgh Law School. He is an overseas veteran of World War I, which he entered as a private, becoming a captain in the 302nd Heavy Tank Battalion.

Westinghouse Elects New Officer

George G. Main has been elected by the Board of Directors assistant treasurer and assistant secretary of the Westinghouse Electric & Manufacturing Co., according to an announcement by G. H. Bucher, President.

In his announcement Mr. Bucher said that Mr. Main, in addition to his new duties, would assume the responsibility as the Company's credit manager. The new official will have his office in the Union Bank Building in Pittsburgh.

Mr. Main, who joined Westinghouse in 1926, the year he received his Bachelor of Science degree in Business Administration from the University of Pittsburgh, was first employed in the Company's East Pittsburgh Works in the Manufacturing department.

He later worked on control of inventories, office incentives and forecasts of business trends and in 1934 was transferred to the Office Methods Division of the Accounting Department. In 1937 he was named manager of the Office Methods Division.

• Keep Informed

In 1938 he was transferred to Mr. Bucher's staff and in 1941 was named assistant director of Financial Accounts Division of the Accounting Department at Pittsburgh Headquarters. In 1943 he was made manager of accounting at the Westinghouse Lamp Division, Bloomfield, New Jersey. He was transferred that same year to the comptroller's staff at Pittsburgh.

Mr. Main was born in Avalon, Pa., on September 30, 1904, and received his education in Pittsburgh schools, being graduated from Peabody High School in 1922 and the University of Pittsburgh in 1926.

Mr. Main is a member of the National Association of Cost Accountants, and has also served on the agency audit committee of the Pittsburgh Community Fund.

Briggs Clarifier Co. Appoints La Touche

Briggs Clarifier Co., Washington, D. C. and Bethesda, Md., manufacturers of Industrial, Aviation, Marine and Automotive Oil Filtration Equipment, announced today the appointment of E. Digges La Touche to administer the Field Service Engineering Staff of the Aviation Division.

The Briggs Co., which is now supplying oil maintenance equipment to the Army, Navy, Coast Guard and Maritime Commission as well as high priority War Industries, is also producing the vitally important Mobile Oil Clarifier for the Army and Navy Air Forces.

Mr. Digges La Touche is also responsible for the development of Foreign Markets for Briggs Aircraft Ground Clarifiers.

Previous to the appointment by Briggs, Mr. Digges La Touche was Executive Assistant to the Director General of the British Air Commission, which is charged with procurement, expediting and distribution of aircraft for Great Britain, having gone to that position from the staff of a New York investment firm.

The revolutionary oil clarifier, which saves time and labor; and increases operating efficiency, will be available for postwar commercial aviation. At the present time all Briggs production lines lead to the war effort.

Wickwire Spencer Appoints Bekaert Comptroller

E. P. Holder, President, announced the appointment of A. C. Bekaert as Comptroller of the Wickwire Spencer Steel Co. and subsidiaries.

Mr. Bekaert has been associated with Wickwire Spencer since 1943 as Assistant Treasurer. Previously he had been an instructor in accounting at C. C. N. Y. and had maintained his own public accounting practice. He is a certified public accountant.

In his new position Mr. Bekaert will act as Comptroller for Wickwire Spencer's subsidiaries, the American Wire Fabrics Corp., Wickwire Spencer Metallurgical Corp., and the Wickwire Spencer Aviation Corp., as well as for the parent company.

He will make his headquarters at the company's executive offices, 500 Fifth Avenue, New York 18, N. Y.

Kieley & Mueller Appoint New Pittsburgh Agent

Kieley & Mueller, Inc., North Bergen, N. J., announce the appointment of the Jno. D. Hiles Co., Plaza Building, Pittsburgh, Pa., as agents in that area for the K & M line of over 200 level and pressure controls and steam specialties.

Continued on Page 50

• Keep Informed . . .

• LATEST CATALOGS

Convertors for Induction Heating Operations

Detailed information on the first standard mercury arc converters designed for induction heating operations in the 500–2000 cycles frequency range is presented in a well-illustrated 8-page bulletin just issued by the Allis-Chalmers Mfg. Co.

How Allis-Chalmers supplies all essential apparatus for complete induction heating installations, including coils, furnaces, and cubicles is explained by a drawing and wiring diagram of a typical mercury arc converter installation. As frequency changer equipment, the Excitron mercury arc converters have a conversion efficiency of 90 percent or better. Units are built to supply power for induction heating in blocks of 250, 500, and 1000 kilowatts and higher.

Graphs and "exploded" views of the Excitron converter compare it favorably to other types of equipment used for induction heating. Differences between the old way and the new way of heating and melting metals are summarized in quick-reading, illustrated form.

The bulletin, B6373, may be obtained by request from the Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Cast Iron Fin Type Radiation

D. J. Murray Manufacturing Co., Wausau, Wis., has just issued a 6-page folder describing the cast iron "fin" type radiation, (patented) design and construction, based on years of operation. Contains charts and illustrations, with installation views of cast iron "Grid" Unit Heaters, dimensional drawings, capacity tables, supply and return connections drawings, etc. Explanation of "carry-over" of heat due to material of construction.

Grinding With Oil

Information of interest to any one concerned with precision grinding is contained in the twelve-page booklet "Grinding With Oil," just published by D. A. Stuart Oil Co. The use of straight oils for thread grinding, gear grinding, and other precision grinding operations is discussed and well illustrated. One unusual feature of the booklet is a chart comparing the wheel markings of several of the larger grinding wheel manufacturers. For free copies write to D. A. Stuart Oil Co., 2741 South Troy Street, Chicago 23, Illinois.

Electronic Heaters

Application of Allis-Chalmers vacuum tube electronic heaters for both induction heating of metals and dielectric heating of non-metallic materials is explained in a well-illustrated, fully descriptive, 4-page bulletin issued by the Allis-Chalmers Mfg. Co.

How the two types of heating work and the advantages of each are clearly pointed out, and numerous successful applications are indicated. Illustrations of typical production set-ups of the standard 20 kw heater are included.

A list of features of the new Allis-Chalmers electronic heaters announced a few months ago includes a low-loss coupling system to provide adaptability in most applications without the use of radio-frequency transformers, and a three phase rectifier (on sizes 10 kw and larger) to obtain maximum power from the electronic heater and to prevent unbalance of the power line. Automatic timing for each unit operation assures uniform quality of production, with timing predetermined by test.

The bulletin, B6372, may be obtained by request from Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Decimal Equivalents

Steel and Tubes Div., Republic Steel Corp., 224 East 131st St., Cleveland 8, Ohio, announces that they have available a new card folder containing decimal equivalents for fractional parts of a foot.

New Bulletin Describes Cathodic Method of Preventing Rusting

Bulletin No. R-181—just issued—describes Rusta Restor, the cathodic, i. e., electrical, method that prevents rusting of steel water tanks, piping, and other steel structures. The bulletin illustrates the action with simple, easy to understand experiments, describes the equipment, includes a table of comparative costs, etc. No obligation. Write The Johnston & Jennings Co., 864 Addison Road, Cleveland 14, Ohio.

Ever-Grip Clamps

Pollak Manufacturing Co., Arlington, N. J., have just issued a new folder describing their "Ever-Grip" Clamp for Aircraft Exhaust Systems. This company makes precision products and maintains an experienced and versatile technical staff for research, development and designing of products and for manufacturing methods.